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Abbreviations

Abbreviation	Definition
ICT	Information and communication technologies
ITF	International Transport Forum
ITS	Intelligent transport systems
OEM	Original equipment manufacturer

Executive summary

The objective of this study was to assess the experiences of end-users before and after testing three selected systems at the iMobility Challenge events. The primary objective of the demonstration activities was to increase the awareness of consumers and decision-makers of the systems, not collecting data for research. However, the data analysed in the present report offers insight into attitude trends when users get a chance to try technologies for themselves.

The data for the study was collected via questionnaires which were directed to the users who tested the following three technologies in different iMobility Challenge events: emergency braking, traffic light assistant and parking assistance systems. In total, 42 stakeholders responded to the questionnaire. The questionnaire included four types of questions: background questions which were directed to all respondents, before-after questions which were directed to all respondents, before-after questions related to traffic light assistant and after questions related to all systems. The formulation of each question is presented in the following.

The results indicate that car users' perceptions about the systems generally became more positive after they had participated in demonstrations of the systems and used the systems by themselves. The results for park assist were partly contradictory, but this can be explained with the fact that the system required more from the driver in terms of interaction between the driver and the in-vehicle user interface than the other demonstrated systems.

The results of the iMobility Challenge study on car users' awareness and demand (Öörni & Penttinen, 2014) indicated that about a half of European car users are aware of in-vehicle ITS systems like emergency braking or eco-driving assistance, but only a minority of drivers has used the systems by themselves. The results of this study, supported by the previous results, suggest that the user perceptions of the systems may become more positive when drivers obtain first-hand experience of the systems. In practise, this can be realised in different ways such as demonstration activities, marketing efforts of car dealers, temporary use of an equipped vehicle (such as a rental car or a company car), exchange of information within peer groups or use of an equipped vehicle at driving school for practising.

The conclusions of this study are based on data on a small and self-selected group of drivers. Therefore, it would be beneficial to verify this in a study with a larger number of users, a more representative user group and possibly in a more controlled setting.

1. Introduction

1.1 Background

The iMobility Challenge project aims to demonstrate, promote and boost the deployment of ICT systems for energy efficient and sustainable mobility. The project also takes safety into account in all its activities because safety is an essential element of sustainability of transport and mobility of people and thus safety is also reflected in the work carried out by iMobility Forum. iMobility Challenge is the successor of eSafety Challenge project launched by EC in 2009. While the main focus of the eSafety Challenge project was in intelligent car systems and safety, the iMobility Challenge project focuses on ICT systems facilitating energy efficient and sustainable mobility.

In addition to the promotion of ICT systems for energy efficient and sustainable mobility, iMobility Challenge has carried out support studies i) to study the deployment status and impacts of the systems ii) to assess consumer awareness and demand and ii) to obtain feedback from the users of the systems. These support studies contributed to the objectives of the project by providing support material and knowledge for dissemination, communication and campaigning.

The first support studies provided the mapping of systems available for demonstration and promotion (Öörni & Schirokoff, 2013) and mapping of products and services on the market (Konstantinopoulou et al., 2013). These studies were carried out immediately after the start of the project and their results were used to select the systems to be promoted to consumers and decision-makers in iMobility Challenge.

The third of the support studies – the study on car users' awareness and demand – analysed car users' awareness of selected iMobility technologies (speed alert, emergency braking, eco-driving assistance, real-time traffic information, start-stop assistance and tire pressure monitoring system) (Öörni & Penttinen, 2014). In addition to user awareness, car users' willingness to pay and car purchasing preferences were included as separate topics. The study was focused on technologies which were already on the market, contributed to more sustainable transport or other objectives of the iMobility Forum and were either systems selected for promotion to consumers in iMobility Challenge or were included in the list of priority iMobility systems created by the Implementation Road Maps working group of the iMobility Forum.

The promotion activities performed by iMobility Challenge involved demonstrations where the users could try and experience the systems. The primary objective of the demonstrations was to increase users' awareness of the systems, but it was considered necessary and interesting to collect user feedback before and after participation in system demonstrations.

The results of iMobility Challenge mapping of systems (Öörni & Schirokoff, 2013) were used to select the systems which were to be promoted with live demonstrations. However, there were also other factors which had to be taken into account when selecting systems to be demonstrated, essentially practical issues such as the availability of suppliers and automotive manufacturers to provide demonstrations at iMobility Challenge events.

In this study the users were able to test the following three technologies in different iMobility Challenge events: emergency braking, traffic light assistant and parking assist. From these systems emergency braking had the main focus on improving safety, traffic light assistant improving energy efficiency and park assist improving the comfort of the user. Emergency braking was analysed in iMobility Challenge study on car users' awareness and demand, it was included in the mapping of systems performed early in the project and it is also one of the vehicle based priority iMobility systems. Traffic light assistance has functionality which is comparable to the dynamic traffic light optimisation and optimum speed advisory system identified in iMobility Challenge mapping of systems to be promoted to decision-makers. Park assist was not in the scope of the previous support studies performed in iMobility Challenge due to its nature as a comfort system.

1.2 Objectives

The objective of the study was to assess the experiences of end-users before and after testing the three selected systems at the iMobility Challenge events. In addition, the original aim was to provide a comparative analysis of differences in users' feedback across different countries. In practice, this was difficult to achieve due to the limitations of data available from iMobility Challenge demonstrations. While many demonstrations were performed at iMobility Challenge events, it was not always feasible to ask users to fill attitude questionnaires (time constraints / sometimes lack of agreement from technology supplier to conduct questionnaires).

The primary objective of the demonstration activities was to increase the awareness of consumers and decision-makers of the systems, not collecting data for research. It was therefore not possible to plan the demonstrations in a way they would provide optimal data set for research purposes. However, the data analysed in the present report offers insight into attitude trends when users get a chance to try technologies for themselves.

For the reasons above, it was considered necessary to redefine the objective of the study to obtain as many relevant results as possible from the data set collected in iMobility Challenge demonstrations. Because the data set was relatively small (42 questionnaires), it was not realistic to analyse the differences between countries. Instead, the focus was set on comparison between systems and the comparison of attitudes before and after participating in a demonstration. The high-level objective – assessing the experiences of end-users before and after testing the systems – remained the same.

2. Method

2.1 Data collection

The data for this study was collected via questionnaires which were directed to the users (mainly consumers and decision-makers) who tested the following three technologies in the demonstrations organised during three iMobility Challenge events: emergency braking, traffic light assistant and parking assist. More detailed information about the demonstrations is included as part of chapter 3 of this report.

Abswers to questionnaires were collected on paper (due to lack of internet connectivity at time to conduct electronically). Questionnaires were then scanned and the results manually exported to electronic format to conduct the analysis.

2.2 Content of the questionnaire

The questionnaires were directed to measure the attitudes of the users before and after the demonstrations of the systems. The number of the questions included in the questionnaire slightly varied with the event. The most questions were asked related to the Traffic light assistant because of the setting of the demos: this demo took place throughout an entire day, and the demo itself was fairly long (15–20 minutes). Therefore, the volunteers had much more time to respond to the questionnaire. Further questions were also asked because of the nature of the technology: the traffic light assisatnt demo was a cooperative ITS demo, it was therefore interesting to ask the degree of trust the users had that they would receive accurate information in real time.

The questionnaire included four types of questions: Background questions which were directed to all respondents, before-after questions which were directed to all respondents, before-after questions related to traffic light assistant and after questions related to all systems. The formulation of each question is presented in the following. Also, since it is a technology with as its core purpose energy-efficinecy, more questions realted to energy-efficiency were asked for that demo.

Background questions (all respondents)

1. Please indicate your gender (male/female)
2. Please indicate you age group (18–24/25–34/35–44/45–54/55–64/65–74/75+)
3. Which of the following stakeholder groups do you belong to?
   - Policy maker
   - Authority (transport sector)
   - Transport research (e.g. research institute, university)
   - Industry (e.g. OEM, car manufacturer)
   - Consulting (e.g. planning, implementation)
   - Professional (non-transport sector)
   - Student
   - Press/media
   - Other

Before-after questions (all systems)

1. How much do you think this system improves safety? (scale 1–5; 1= not at all, 5=completely)
2. Do you think your stress associated with travelling changes with your access to the service? (scale 1–7; 1= will radically decrease, 7=will radically increase)
3. How easy do you think it is to use the system? (scale 1–7; 1=very difficult, 7=very easy)
4. How do you judge the overall potential benefit of having this system in your car? (scale 1–5; 1=little benefit, 5=high benefit)
5. How useful is this system? (scale 1–5; 1=not at all, 5 completely)
6. Would you consider paying to be able to use this system? (scale 1–5; 1=definitely not, 5=definitely yes)

Before-after questions (only related to Traffic light assistant)

1. To what degree do you trust the system can provide you with accurate information and in real-time? (scale 1–5; 1=not at all, 5=completely)
2. Do you think the time it takes you to reach your destination changes with access to this system? (scale 1–7; 1=will radically decrease, 7= will radically increase)
3. Do you think your fuel consumption changes thanks to this system? (scale 1–7; 1=will radically decrease, 7=will radically increase)
4. How much do you think this system improves green driving? (scale 1–5; 1=not at all, 5=completely)

After questions (all systems)

1. Has your impression of the system changed during the course of the demo? (scale 1–7; 1=more negative, 7=more positive)
2. Did you find the information provided by the system comprehensive? (scale 1–5; 1=not at all, 5=completely)
3. Did you find the information displayed distracting at any time to the driver? (scale 1–5; 1=not at all, 5=completely)
4. What is your overall reaction to the system? (scale 1–7; 1=very negative, 7=very positive)

3. Demonstration of systems

The demonstrations were held in three iMobility Challenge events: in The Hague in September 2013, in Leipzig in May 2013 and in Helsinki in June 2014. In Leipzig the demonstration was organised in conjunction with the International Transport Forum, which is a yearly event attracting public authorities and professionals from the field of transportation. It was therefore an event for decision-makers and professionals. In The Hague and in Helsinki, the events were open to both professionals from the transport sector and members of the general public.

The demonstrations were provided as real test drives in passenger cars (conventional combustion engine cars). The users responding to the questionnaire actually drove the car, and an instructor sat in the passenger seat to explain about the functioning of the system.

The Traffic Light Assistance demo in Leizpig was in real traffic conditions in the city of Leipzig (where traffic light infrastructure is equipped with a communication device enabling the system). The Traffic Light Assistance demonstration in The Hague was organised in a test track (an airport runway closed off for the event) where the infrastructure (traffic lights equipped with communication device) was installed on purpose for the demonstration event.

The demonstrations related to Emergency Braking and Park Assist were conducted in a test track (on a car park closed off for the event), not in real traffic. More detailed descriptions of the demonstrations can be found from the following subchapters (3.1–3.3).

Each time a participant registered for a test-drive they were asked to take a few minutes before and the demo to complete the paper questionnaire, and again after the demo was completed. Few, but some participants who took part in the demos declined to answer the questionnaires because of time constraints.

3.1 Traffic Light Assistant demonstration

On May 22nd 2013 in Leipzig, iMobility Challenge demonstrated a cooperative vehicle to infrastructure Traffic Light Assistant application, provided by BMW. The system displays information about traffic light phases in the vehicle's dashboard, helping the driver to adjust his/her speed to reduce sudden acceleration or braking or to avoid unnecessary engine start stops at traffic lights (Figure 1).

Figure 1. Snapshot of the real time traffic light phasing information provided to the user on his dashboard during the demonstration.

The same system was also demonstrated at the iMobility Challenge event in The Hague on 11th September 2013. In both cases the systems were systems under development (not commercially available).

3.2 Emergency Braking

On 16th June 2014 in Helsinki iMobility Challenge organised an autonomous emergency braking demonstration provided by Volvo. The particular systems provided for the demo was called 'City Safety' and is designed for low speed driving in traffic. The cars used in the demonstrations were equipped with a radar to detect the likely collision and to brake automatically when needed (Figure 2).

Figure 2. The demonstration of Emergency Braking, the vehicle brakes autonomously in front of an obstacle in case the driver is not reacting on time.

The system demonstrated at the event was already commercially available at the time of the demonstration.

3.3 Park Assist

At the same event in Helsinki, a park assist system was presented by Citroën. Park assist is an active parking aid that first detects a suitable space and then guides the vehicle to do a parallel parking manoeuver. When the car detects that parking is possible, the driver selects the reverse gear, and only need to accelerate and brake during the manoeuver (no need to steer the vehicle's steering wheel) (Figure 3). When the driver is next to a parking space or when he or she is already parked in a space and wants to exit, the driver needs to press a button on the steering wheel to activate the system, and select the scenario on the car's central display screen (whether he is entering or exiting a space). When parking, the system warns the driver whether or not the selected parking space is big enough to allow the vehicle to park. In both scenarios (entering or exiting a space) the system provides instructions as to the maximum speed at which the driver should perform the manoeuver.

Figure 3. A snapshot of the information provided in the central display screen of the car when using the Park Assist system.

The system was commercially available at the time of the demonstration.

4. Results

4.1 Respondents

The demonstrations for which questionnairesd were collected were held in three iMobility Challenge events: in The Hague in September 2013, in Leipzig in May 2013 and in Helsinki in June 2014. Traffic light assistant was demonstrated in the events in Hague and Leipzig and emergency braking and park assist in Helsinki.

In total, 42 stakeholders responded to the questionnaire. The number of responses by event and by system is presented in Table 1.

Table 1. The number and share of responses by event and by system (n=42).

	Event			
	Hague	**Leipzig**	**Helsinki**	**Total**
Emergency braking	0 (0%)	0 (0%)	10 (34%)	10 (24%)
Park assist	0 (0%)	0 (0%)	19 (66%)	19 (45%)
Traffic light assistant	2 (100%)	11 (100%)	0 (0%)	13 (31%)
Total	2 (100%)	11 (100%)	29 (100%)	42 (100%)

Most respondents were male related to all systems (Table 2). Two replies did not include information on the gender.

Table 2. The number and share of responses by gender and by system (n=40).

	Gender		
	Male	**Female**	**Total**
Emergency braking	7 (19%)	1 (25%)	8 (20%)
Park assist	18 (50%)	1 (25%)	19 (48%)
Traffic light assistant	11 (31%)	2 (50%)	13 (32%)
Total	36 (100%)	4 (100%)	40 (100%)

The responses were divided quite evenly among the age groups (Table 3). Two replies did not include information on the age group.

Table 3. The number and share of responses by age group and by system (n=40).

	Age group							
	18–24	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**75+**	**Total**
Emergency braking	1 (25%)	1 (14%)	1 (11%)	2 (25%)	1 (14%)	2 (40%)	0 (0%)	8 (20%)
Park assist	1 (25%)	3 (43%)	6 (67%)	2 (25%)	4 (57%)	3 (60%)	0 (0%)	19 (48%)
Traffic light assistant	2 (50%)	3 (43%)	2 (22%)	4 (50%)	2 (29%)	0 (0%)	0 (0%)	13 (32%)
Total	4 (100%)	7 (100%)	9 (100%)	8 (100%)	7 (100%)	5 (100%)	0 (0%)	40 (100%)

Most respondents were transport researchers or people from industry (Table 4). The respondents in the other category stated themselves as ITF staff, representative of media, working in tolling business or car user. Six respondents did not provide any clarification. Three replies did not include information on the age group.

Table 4. The number and share of responses by stakeholder and by system (n=39).

	Stakeholder									
	Policy maker	**Authority**	**Transport research**	**Industry**	**Consulting**	**Professional**	**Student**	**Press**	**Other (general public)**	**Total**
Emergency braking	0 (0%)	0 (0%)	2 (33%)	2 (25%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	3 (30%)	8 (20%)
Park assist	0 (0%)	1 (50%)	3 (50%)	3 (37%)	1 (50%)	3 (100%)	1 (50%)	2 (67%)	5 (50%)	19 (49%)
Traffic light assistant	3 (100%)	1 (50%)	1 (17%)	3 (38%)	1 (50%)	0 (0%)	0 (0%)	1 (33%)	2 (20%)	12 (31%)
Total	3 (100%)	2 (100%)	6 (100%)	8 (100%)	2 (100%)	3 (100%)	2 (100%)	3 (100%)	10 (100%)	39 (100%)

4.2 Results

4.2.1 Before-after questions (all systems)

4.2.1.1 How much do you think this system improves safety?

In general, the respondents estimated that the system use will somewhat improve the safety (Figure 1). Related to park assist and traffic light assistant there were, however, few respondents who were not convinced about the safety effect of the system.

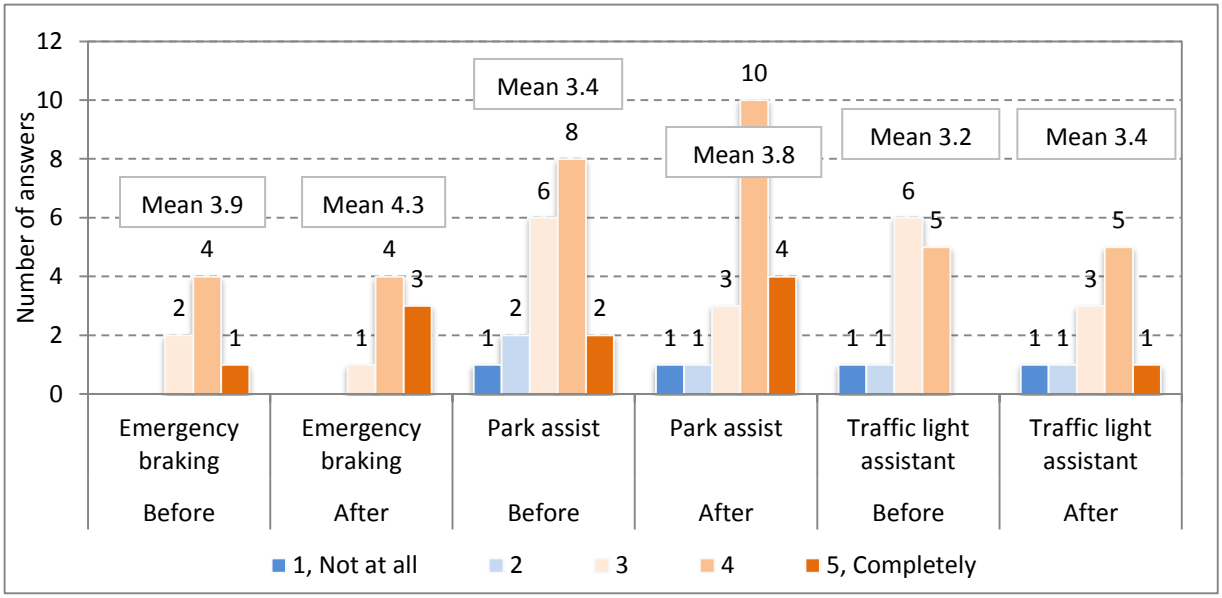

Figure 1. Before and after answers by system (n_{before}=39, n_{after}=38).

4.2.1.2 Do you think your stress associated with travelling changes with your access to the service?

The responses related to the stress associated with travelling were slightly contradicting. The respondents estimated that the stress related to the use of emergency braking and traffic light assistant was smaller after the demonstration compared to the situation before whereas they estimated that the stress related to the use of park assistant was higher after the demonstration (Figure 2). Overall, there was quite high variety in the responses. Even regarding emergency braking and traffic light assistant there were respondents who viewed that the stress will increase due to the use of the system.

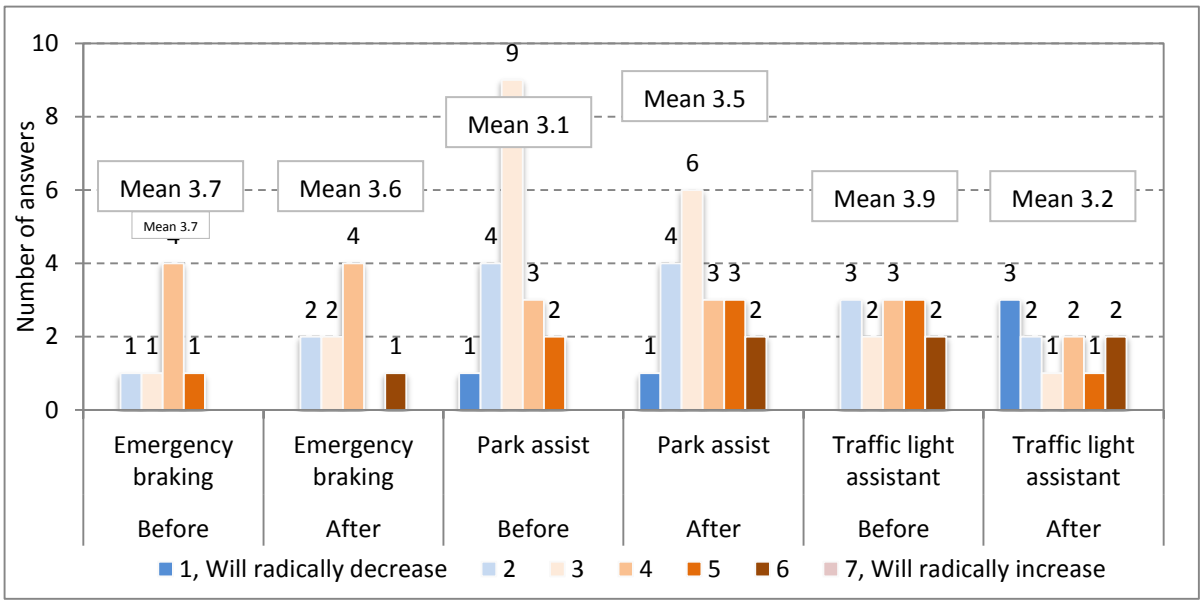

Figure 2. Before and after answers by system (n_{before}=39, n_{after}=39.

4.2.1.3 How easy do you think it is to use the system?

The respondents stated that the after the demonstration it was clearly easier to use both emergency braking and traffic light assistant (Figure 3). Park assist was considered more difficult to use after the demonstration compared to the situation before.

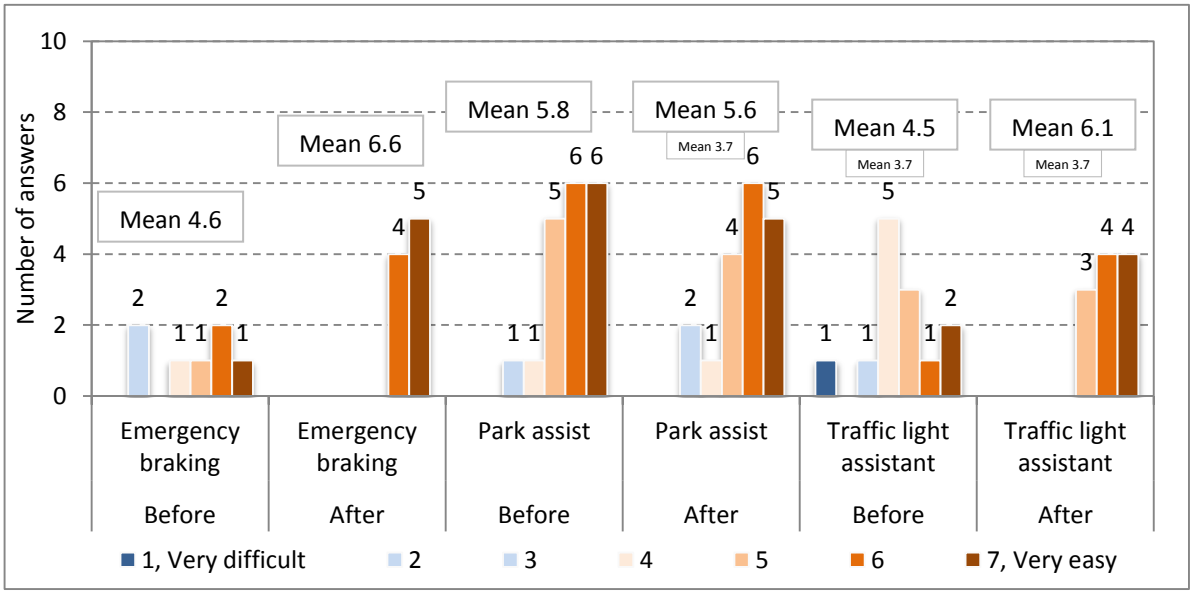

Figure 3. Before and after answers by system (n_{before}=39, n_{after}=38).

4.2.1.4 How do you judge the overall potential benefit of having this system in your car?

Emergency braking was assessed to have the highest overall potential benefit of the systems (Figure 4). The overall potential benefit of all systems was estimated to be slightly higher after the demonstration compared to the situation before.

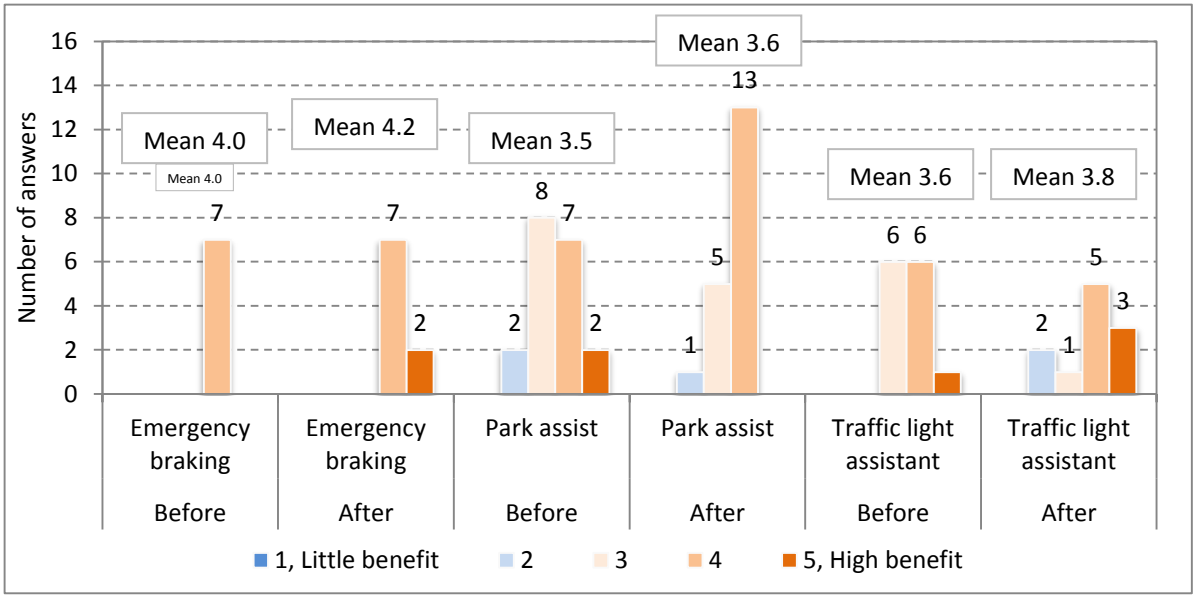

Figure 4. Before and after answers by system (n_{before}=39, n_{after}=39).

4.2.1.5 How useful is this system?

Emergency braking system was considered as the most useful system both before and after the demonstration (Figure 5). The usefulness of all the systems experienced by the users improved after the demonstration. It must be noted that after the demonstration there were few respondents who did not view traffic light assistant as useful even though they did it before the demonstration.

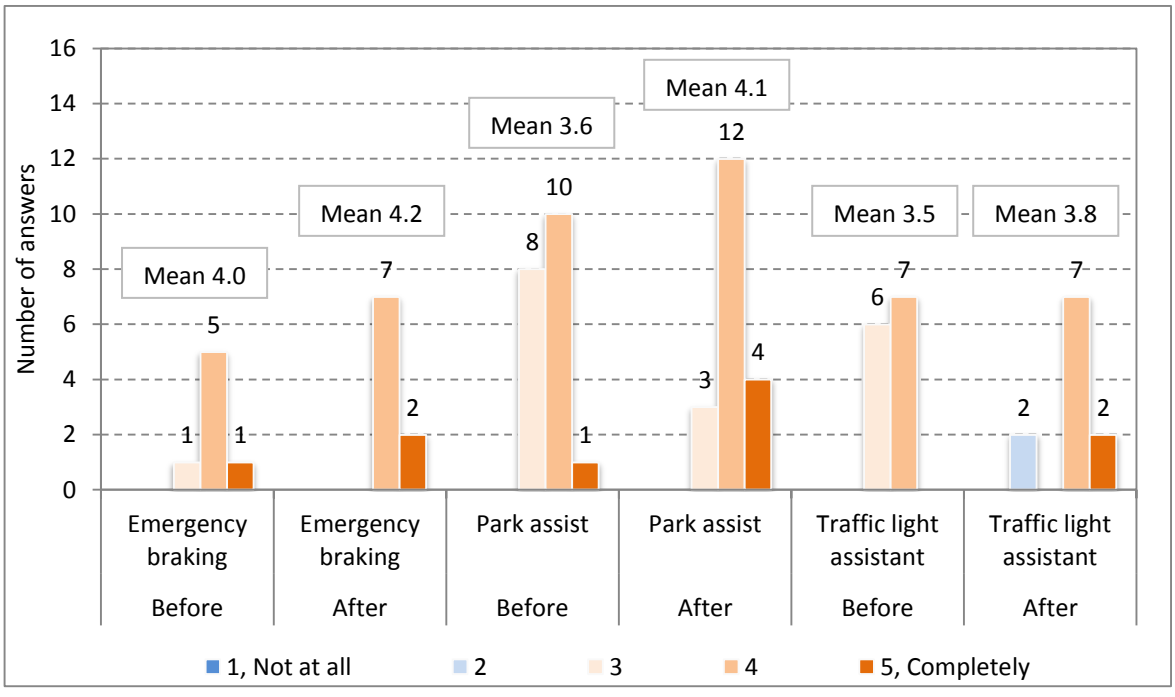

Figure 5. Before and after answers by system (n_{before}=39, n_{after}=39).

4.2.1.6 Would you consider paying to be able to use this system?

The willingness to pay for the use of the systems improved related to all demonstrated systems. However, the willingness was not really high. The respondents were most willing to pay for the use of emergency braking and least for the use of traffic light assistant. For traffic light assistant the average willingness to pay was even slightly negative before the demonstration.

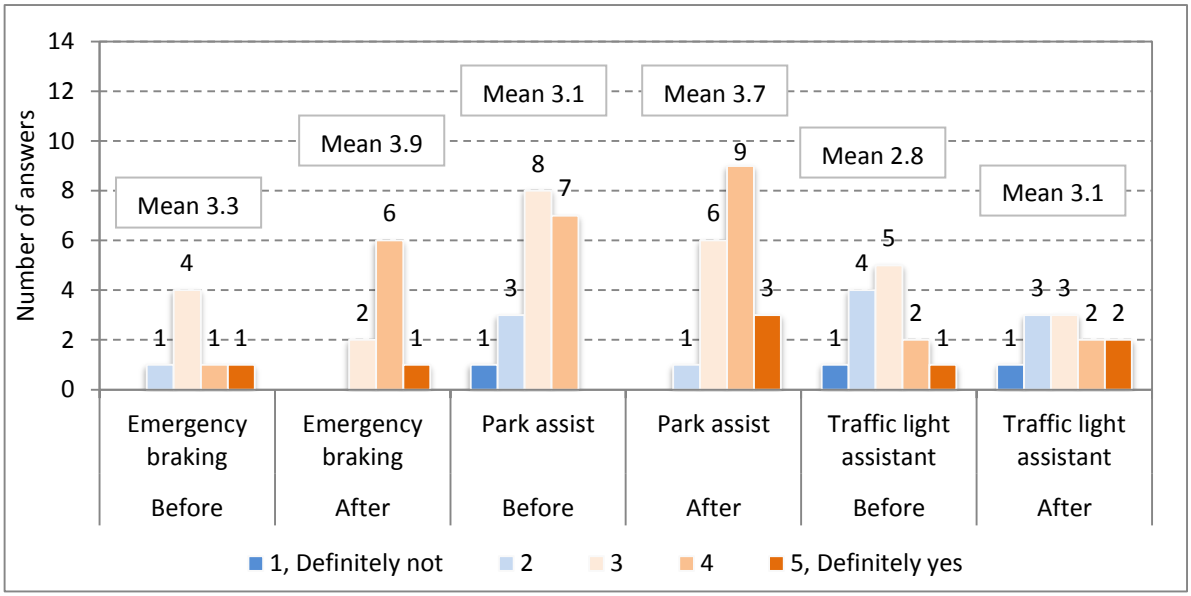

Figure 6. Before and after answers by system (n_{before}=39, n_{after}=39).

4.2.2 Before-after questions (only traffic light assistant)

4.2.2.1 To what degree do you trust the system can provide you with accurate information and in real-time?

After the demonstration the trust of the respondents that traffic light assistant can provide them with accurate information and in real-time somewhat increased (Figure 7). After the demonstration, none of the test persons provided negative answers and more respondents considered the information completely reliable than before the demonstration.

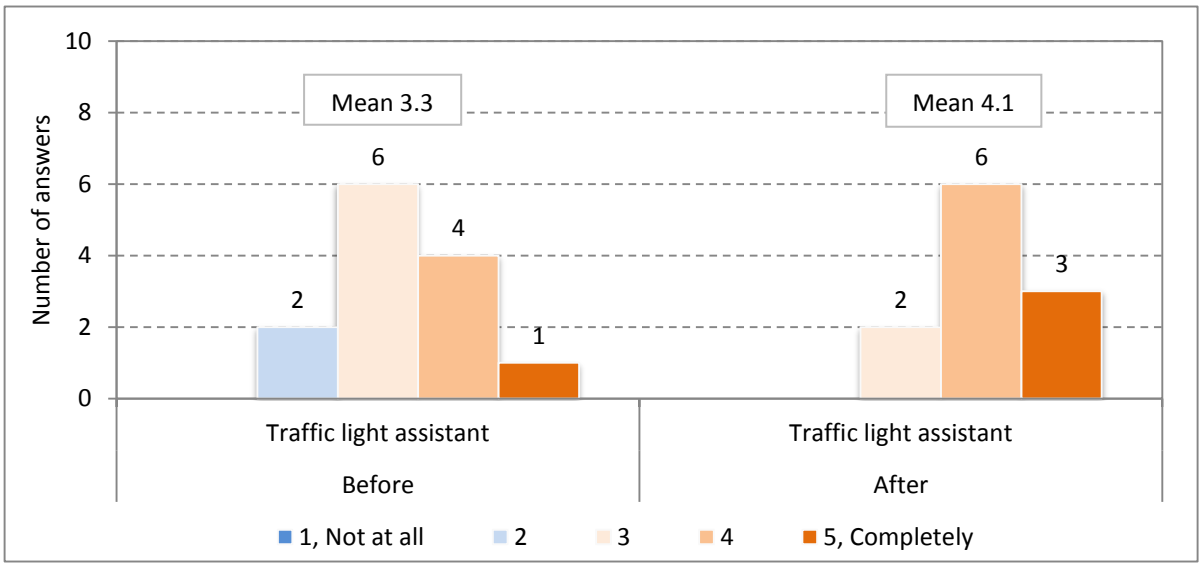

Figure 7. Before and after answers by system (n_{before}=13, n_{after}=11).

4.2.2.2 Do you think the time it takes you to reach your destination changes with access to this system?

Traffic light assistant was considered to slightly decrease the time it takes the user to reach the destination (Figure 8). However, this result was not unanimous and after the demonstration there were still some respondents who estimated that the travel time will increase.

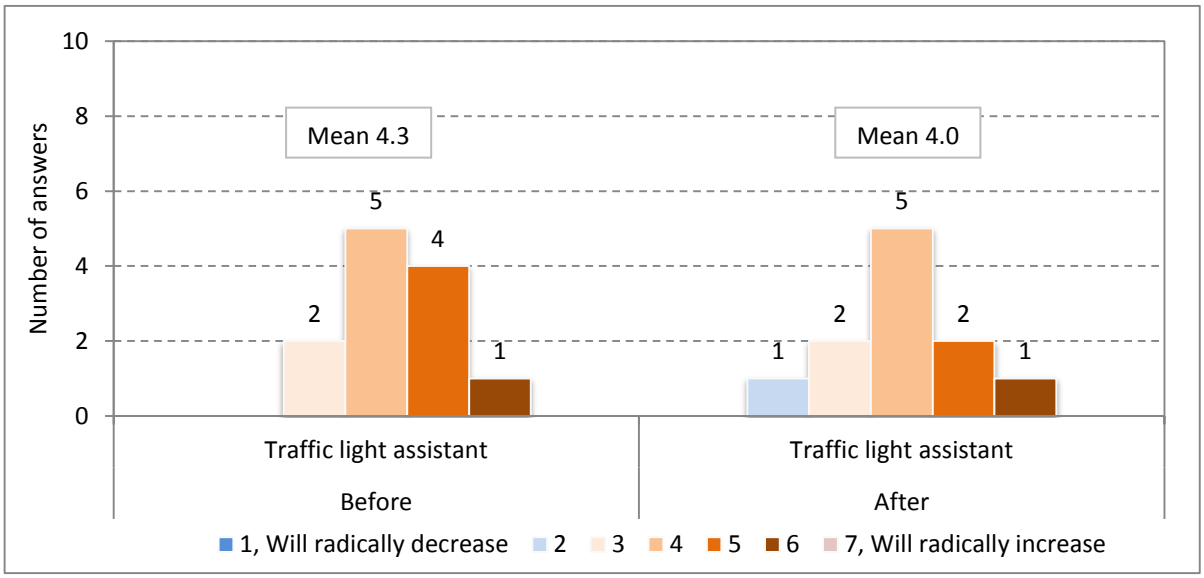

Figure 8. Before and after answers by question (n_{before}=12, n_{after}=11).

4.2.2.3 Do you think your fuel consumption changes thanks to this system?

The fuel consumption was thought to slightly decrease thanks to traffic light assistant (Figure 9). However, this result was not unanimous and after the demonstration there were still some respondents who estimated that the fuel consumption will increase.

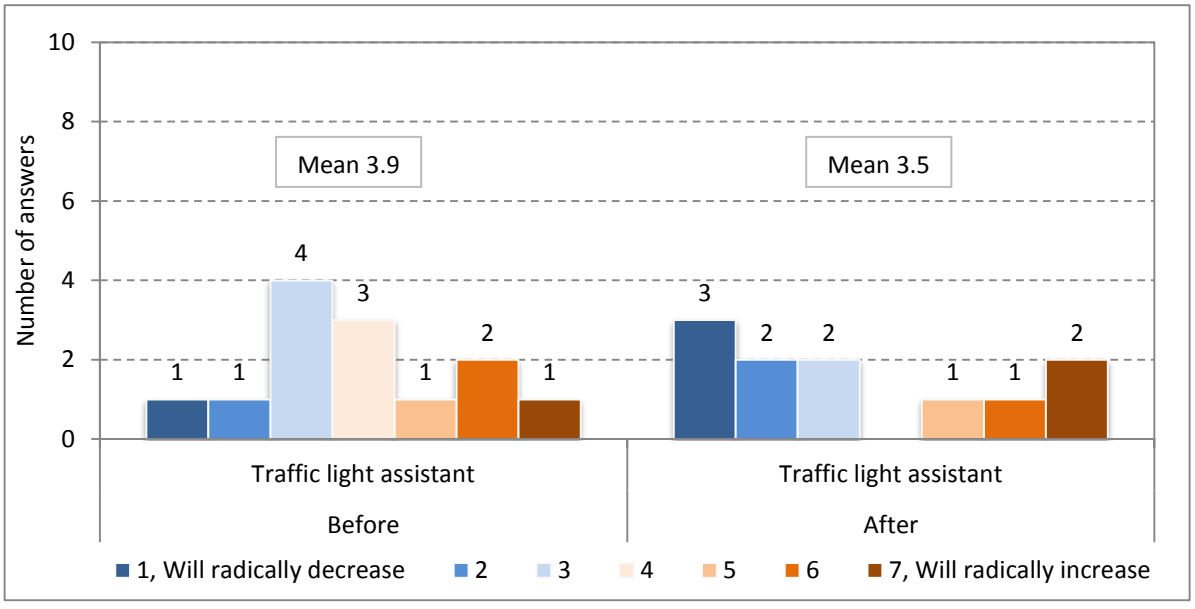

Figure 9. Before and after answers by system (n_{before}=13, n_{after}=11).

4.2.2.4 How much do you think this system improves green driving?

The respondents considered that traffic light assistant will slightly improve green driving (Figure 10). However, this result was not unanimous and after the demonstration there were still some respondents who estimated that the system does not improve green driving.

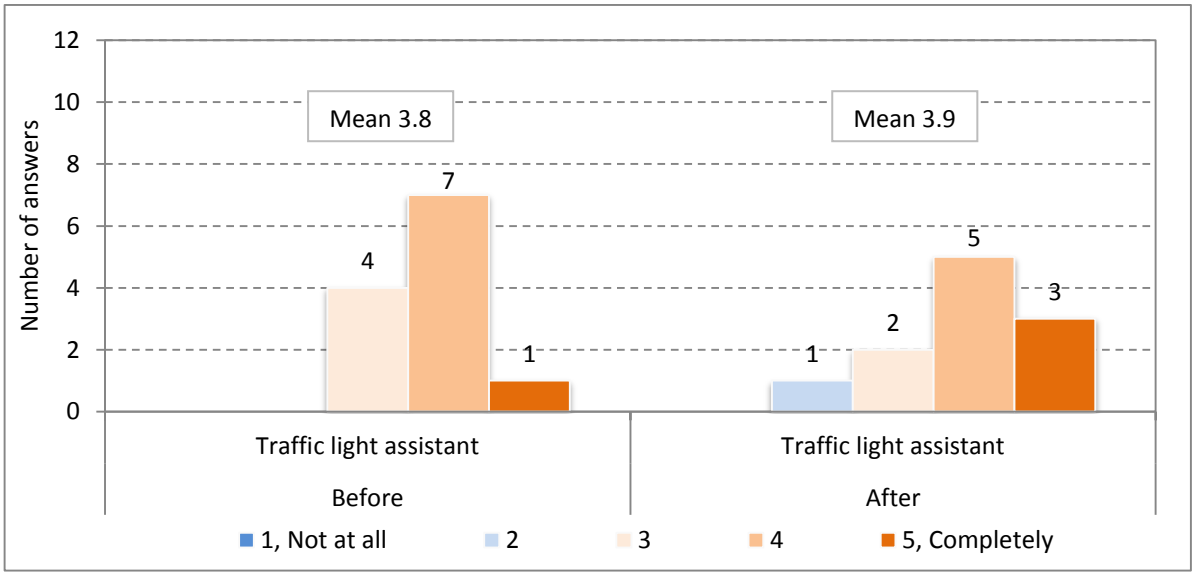

Figure 10. Before and after answers by system (n_{before}=12, n_{after}=11).

4.2.3 After questions (all)

4.2.3.1 Has your impression of the system changed during the course of the demo?

The respondents stated that their impression related to system became more positive after the demonstration concerning all of the systems (Figure 11). However, their impressions were most positive on emergency braking and traffic light assistant than on park assist.

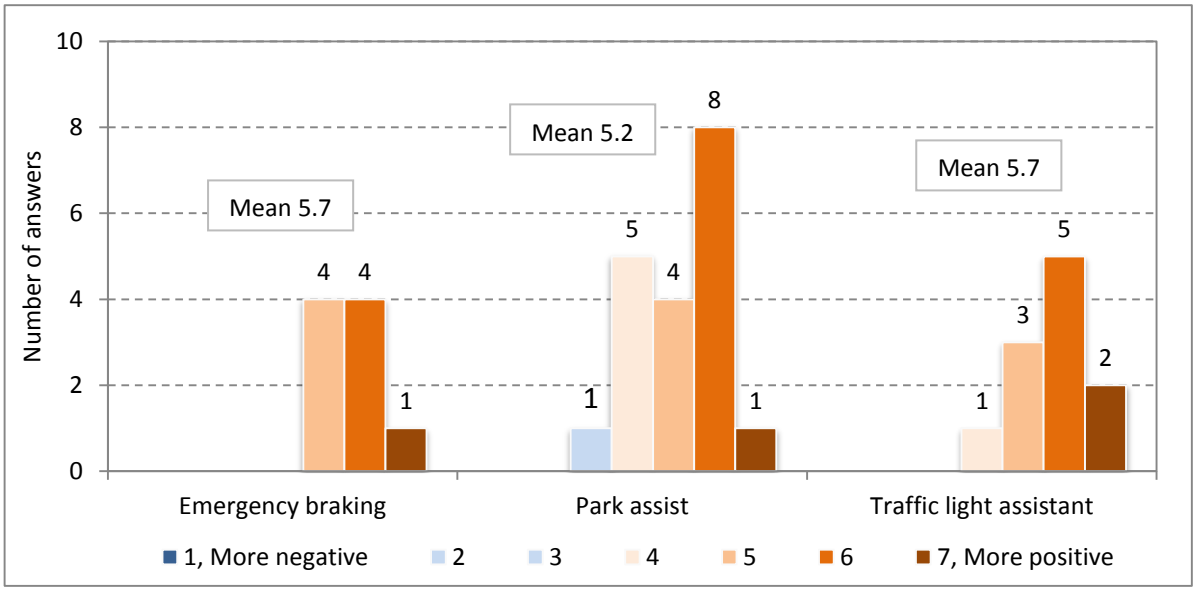

Figure 11. After answers by system (n=39).

4.2.3.2 Did you find the information provided by the system comprehensive?

Traffic light assistant was considered to provide most comprehensive information to the users (Figure 12). It must be noted that there were also respondents whose opinion on this issue was neutral or who considered that the information provided by emergency braking and park assist was not comprehensive.

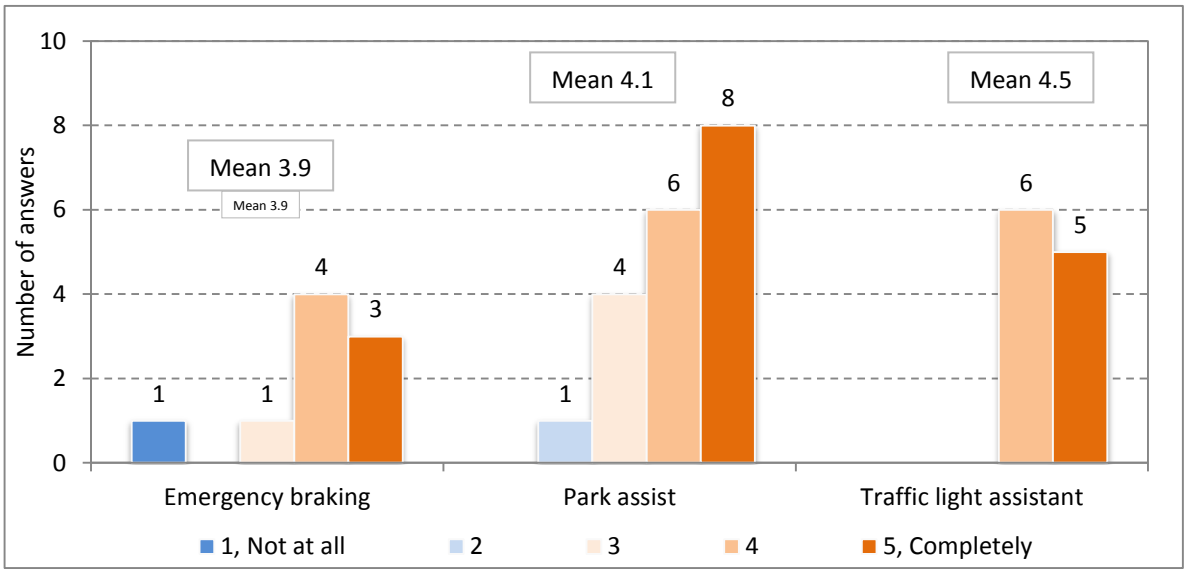

Figure 12. After answers by system (n=39).

4.2.3.3 Did you find the information displayed distracting at any time to the driver?

Based on the responses the most distracting information was provided by traffic light assistant and the least distracting information by emergency braking (Figure 13). It must be noted that regarding all the systems there were also respondents who considered that the information displayed by the system was considered distracting.

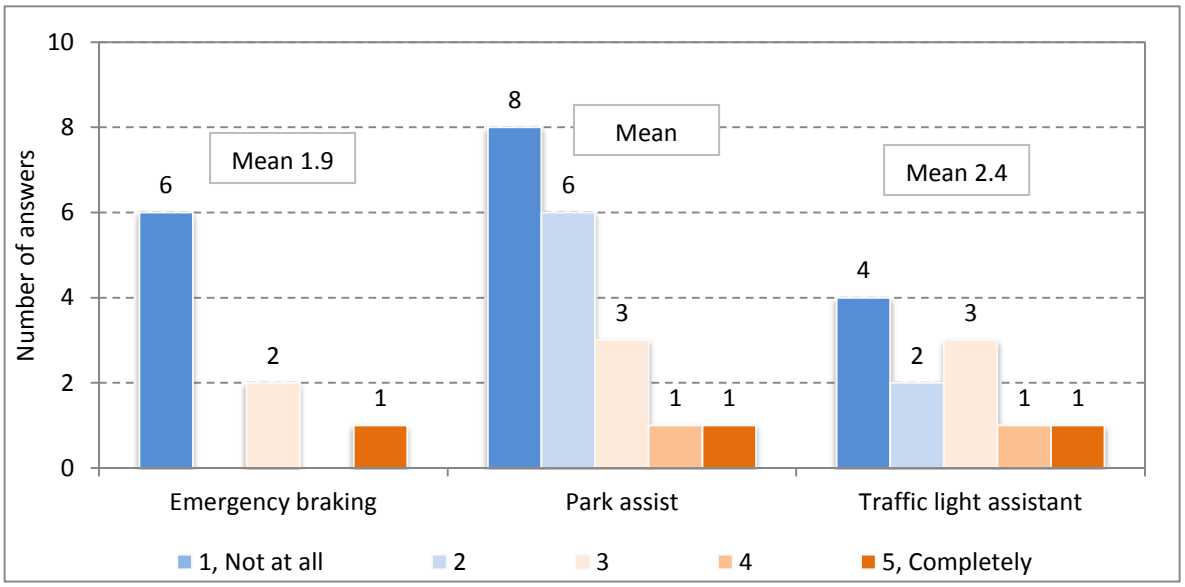

Figure 13. After answers by system (n=39).

4.2.3.4 What is your overall reaction to the system?

The overall reactions of respondents were positive towards all the demonstrated systems (Figure 14). The respondents were most positive towards emergency braking and least positive towards park assist. The replies related to park assist and traffic light assistant had quite high variation and some respondents were even negative about the systems. The reactions of respondents regarding emergency braking were most unanimous.

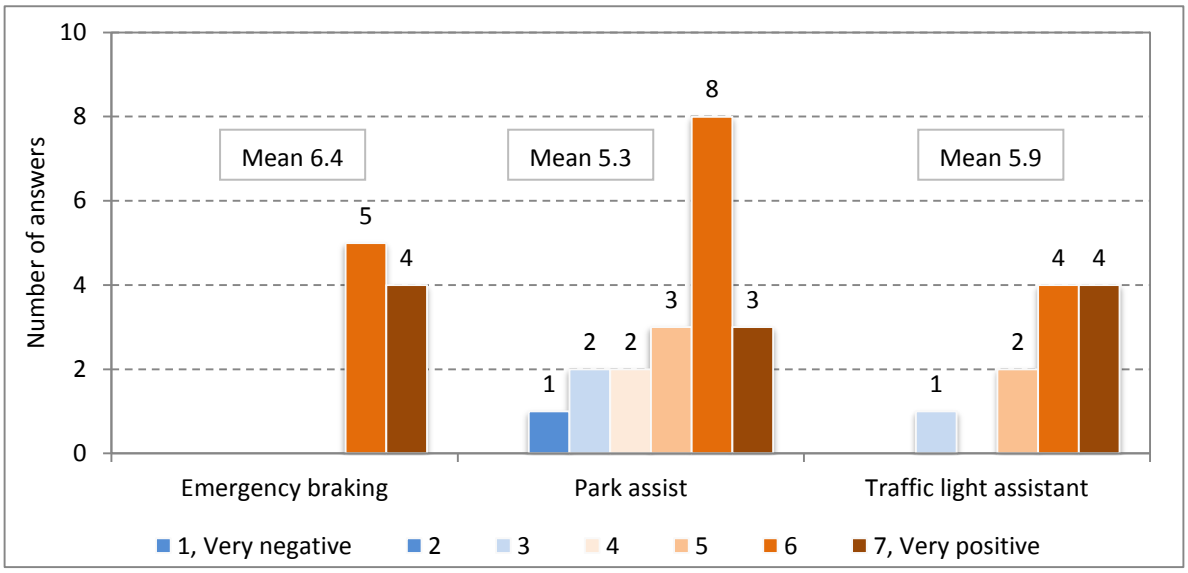

Figure 14. After answers by system (n=39).

5. Discussion of results

5.1. General discussion on results

Before-after (all systems)

After the demonstrations the respondents estimated the safety benefits of all the systems higher than before the demonstration. In general, the highest benefits were estimated related to emergency braking and lowest related to traffic light assistant. In addition, the respondents judged the overall potential benefit of having the systems in their car as well as the usefulness of these systems higher after the demonstration compared to the situation before. However, the increases in the experienced potential benefit and usefulness were minor related to all systems.

Some results related to park assist were somewhat unexpected. After the demonstration the respondents estimated that the stress related to the use of park assist was higher compared to the situation before the demonstration. Moreover, after the demonstration the respondents regarded that it was more difficult to use the system compared to the situation without the demonstration. Perhaps this is due to the fact that the system required a significant level of interaction with the human machine interface of the vehicle: the driver first needed to press a button on the car's steering wheel and to select the desired scenario from the car's central display (whether he wished to enter or exit a parking space) and then to follow the instructions presented on screen. The results related to emergency braking and traffic light assistant were opposite. The stress associated with the systems decreased (more with traffic light assistant than with emergency braking) and the usefulness of the systems was viewed better as before the demonstration. The increase in the estimated usefulness was substantial related to emergency braking and traffic light assistant.

The willingness to pay for the use of systems increased slightly regarding all the systems. The willingness was highest for emergency braking and lowest for traffic light assistant (both before and after the demonstration). The change in the willingness to pay after the demonstrations was higher for emergency braking and park assist than for traffic light assistant. For traffic light assistant the willingness to pay was even slightly negative before the demonstration.

Before-after (traffic light assistant)

The respondents were asked a question about their perceptions on the impact the system has on travel time (Figure 8). Users' perceptions on the impact on travel time were slightly more positive (the system reduces travel time more or increases it with smaller amount) than before participating in the demonstration. Furthermore, perceptions on the impact on fuel consumption were also more positive after demonstration than before it. The share of users who expected the system to reduce fuel consumption was larger after the demonstration (Figure 9). However, the results related to these questions were not unanimous and after the demonstration there were still some respondents who estimated that the travel time and fuel consumption will increase and that the system does not improve green driving.

The highest change was obtained related to the accuracy of the information. After the demonstration, none of the respondents provided negative answers and more respondents considered the information completely reliable than before the demonstration.

After (all systems)

The respondents found the information provided by the systems rather comprehensive. The respondents estimated that the information provided by the traffic light assistant was the most comprehensive while the information provided by the emergency braking was the least comprehensive. However, the opposite trend was valid for the distraction of the information provided by the system. The information provided by the traffic light assistant was viewed as most distracting and the information provided by emergency braking as the least distracting. It must be noted that both regarding the comprehensiveness of the information and distraction there were also respondents who considered that the information was not comprehensive and the information displayed by the system was considered distracting.

The overall impressions and overall reactions of respondents about the systems were more positive towards all systems after the demonstration except for stress related to use and ease of use in case of park assist. This can be at least partly be explained with the fact that the demonstrated park assist system required relatively much interaction between the driver and the in-vehicle user interface of the system compared to other demonstrated systems.

The impressions and overall reactions related to the systems were more positive towards emergency braking and traffic light assistant than park assist. It must be noted that even after the demonstrations there were still some respondents whose overall impressions (park assist) and overall reactions (park assist and traffic light assistant) were negative.

5.2 Data collection

The data set analysed in the study had certain limitations. First, it is possible and even likely that all participants of the demonstrations did not fill in the questionnaire forms. This increases the probability that the user perceptions reported in the study are more positive than the whole group of drivers who participated in demonstrations. Second, the number of responses was limited for all of the three analysed systems. This limited the selection of analysis methods and affected the interpretation of the results. For example, we have not analysed whether the results are statistically significant because it would be difficult to obtain statistically significant results for samples with small number of respondents.

The quality of the implementations used for demonstrations did also likely affect users' perceptions of the systems. In other words, weaker implementations would have led to worse user perceptions of the systems and even more advanced implementations than the tested ones would have improved them further. This has to be taken into account when comparing the results to other studies. In general, the systems operated in a satisfactory way during the demonstrations and the demonstrated systems were either commercial products or at least close to market. This increased the relevancy and value of the study results.

The sample of car drivers analysed in the study was clearly not representative of all car users, and collecting this type of data was not even the aim of the demonstrations. The respondents were

people who voluntarily participated in the demonstrations at the own initiative. Due to the nature of the events where the demonstrations were organised, many of them were also experts in ITS or vehicle technology. It is therefore likely that the attitudes of the respondents towards the demonstrated applications were more positive than the whole population of car users and that their awareness of the benefits and limitations of the systems was better.

5.3 Comparison of results with study on car users' awareness and demand

The previous iMobility Challenge user aspect study (study on car users' awareness and demand, Öörni & Penttinen 2014) indicated that the perceived usefulness of the analysed systems (speed alert, eco-driving assistance, real-time traffic information, start-stop assistance and tire pressure monitoring system) was high among the respondents. In that study, emergency braking was viewed to improve safety the most compared to other systems analysed. The result obtained in this study is consistent with the earlier one: emergency braking was perceived to improve safety more than traffic light assistant or park assist (Figure 1).

In the study of Öörni and Penttinen (2014), on car users' awareness and demand, emergency braking had the lowest self-reported usage compared to the other systems: only 5% of the respondents had tried the system and of those more than 70% had tried it less than five times. This is consistent with the functionality of emergency braking systems available on the market: emergency braking systems initiate a braking only when a collision is certain or almost certain. The system may also issue a warning when there is an obvious risk of collision. In other words, even drivers having their vehicle equipped with the system do not necessarily receive warnings frequently or experience situations in which the vehicle initiates automatic braking.

Emergency braking had the highest willingness to pay compared to the other systems (park assist and traffic light assistant) included in this study (Figure 6). This result is consistent with the results of the study on car users' awareness and demand (Öörni & Penttinen 2014), in which 65% of the respondents had indicated that they would be willing to pay something for the system and this was the highest percentage for the systems covered by the study. The other systems in the study of Öörni & Penttinen (2014) were different, and therefore direct comparison of results was not possible.

6. Conclusions and recommendations for further research

6.1 Conclusions

The results indicate that car users' perceptions about the systems generally became more positive after they had participated in demonstrations of the systems and used the systems by themselves. The results for park assist were partly contradictory, but this can be explained with the fact that the system required more from the driver in terms of interaction between the driver and the in-vehicle user interface than the other demonstrated systems.

The results of the iMobility Challenge study on car users' awareness and demand (Öörni & Penttinen 2014) indicated that about a half of European car users are aware of in-vehicle ITS systems like emergency braking or eco-driving assistance, but only a minority of drivers has used the systems by themselves. The results of this study, supported by the previous results, suggest that the user perceptions of the systems may become more positive when drivers obtain first-hand experience of the systems. In practise, this can be realised in different ways such as demonstration activities, marketing efforts of car dealers, temporary use of an equipped vehicle (such as a rental car or a company car), exchange of information within peer groups or use of an equipped vehicle at driving school for practising.

6.2 Recommendations for further research

This study focused on the users' perceptions before and after experiencing the systems. The results indicate that users' perceptions generally became more positive after using the system in a demonstration. However, this conclusion is based on data on a small and self-selected group of drivers. Therefore, it would be beneficial to verify this in a study with a larger number of users, a more representative user group and possibly in a more controlled setting.

It is likely that more positive attitudes towards the systems also increase the take-up rates of the systems although this has not been studied in detail in iMobility Challenge. The results of the study also indicate that car users generally have more positive perceptions towards the systems after testing them in a demonstration. This leads to the question, how to use demonstrations in an optimal way to change the attitudes of car users and their purchasing behaviour to accelerate the deployment of the systems. Opportunities for demonstrating the systems to car users may be related for example to company and rental car fleets, education provided by driving schools and marketing activities carried out by car dealers.

7. References

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