

A FOCUS GROUP APPROACH TOWARDS AN UNDERSTANDING OF DRIVERS' INTERACTION WITH IN-VEHICLE TECHNOLOGIES

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ABSTRACT: The paper presents the methodology and results from focus group interviews, conducted within the framework of the INTERACTION project. The main aim was to understand why, when, where and how drivers interact with four different IVT, gathering information to understand more about the moments and modalities the drivers choose to interact with IVT. The focus group sessions were conducted in five different European countries and each focus group session promoted the discussion on two IVT: cruise control and speed limiter, or nomadic navigation system and mobile phone. Results express the way drivers think about the advantages and disadvantages of the systems, the moments they select to use them in a proper or unattended way, and even reports of dangerous situations while interacting with them. Discussion allows a reflection on the factors that influence drivers to use the systems and will be used for further research within the INTERACTION project.

1 BACKGROUND

Past researches have already elucidated how drivers may interact with some In-Vehicle Technology (IVT) systems, showing their short-term effects on the driving task. Nowadays researches are focused in observing and analysing real driving situations in order to discover how drivers behave in their own environment.

One of the projects that looked at the interaction with some IVT systems was the AIDE (adaptive integrated driver-vehicle interface) which analysed the interaction with cruise control (CC) and speed limiter (SL). Within this project interviews and the analysis of the drivers' behaviour were conducted to discover the nature of this interaction. Some of the results showed that, during the learning phase, the mental model created initially about the systems may be different from what the driver really encounters when interacting with it, especially in what concerned the feedback provided for certain actions. It was reported that some drivers did not like to use certain system functions like resuming the previous target speed, or activating the kick-down-function on the SL due to a feeling of loss of control. During the learning phase drivers also highlighted drawback aspects: the possibility to suspend the CC by using the clutch and the fact of both CC and SL systems shared a common interface. The

influence on attention and vigilance was not consensual among participants as some considered that these systems could enable them to devote more attention to the driving environment while others believed that CC and SL required more attention, especially during initial learning phases [1].

Surveys made to long-term system owners [2] allowed to verify that the IVT users did not consider that the systems represent a loss of freedom or a constraint to driving. For them, CC and SL were easy to learn and to use and required little time to adapt. Situational context was referred as having an influence on their use. CC was more subject to variations according to the situational context and drivers used it more frequently in highways. SL was generally used more on urban roads and men use it more frequently than women. Both systems were perceived as having beneficial effects as regards to speed control and driving effort. Some negative effects were also reported especially regarding the management of the interaction with other vehicles. Respondents considered that CC changed to a great extent the user's way of driving and that SL had a greater impact to reduce speed [2]. Additionally, focus group carried out in Australia [3] showed the positive attitudes towards CC mainly used on highways or freeways. Rural drivers stated to be using it more than metropolitans and, in general terms, the main reason for using it was to avoid speed penalties. Nevertheless, it was mentioned that drivers often set a higher speed than the limited one.

Surveys with the main aim of studying other in-vehicle information and communication systems like navigation systems (NS) and mobile phones (MP) elucidated that NS are seen as equipments that can contribute to prevent drivers getting lost [4]. They can assist the driver to find alternative routes, and allow for more equal distributions of the traffic through the transportation network. Recent work from Lee and Cheng [5] showed that, when looking for an unfamiliar destination, drivers perform better with a NS, when compared to the use of a map, in terms of efficiency to get to the destination and in terms of driving performance. Despite some inadequate features of the equipment, the driving performance was evaluated as safer [5]. This finding confirms that using NS can augment the confidence and safety in driving [6]. Results from surveys [3] [7] pointed out different needs of information depending on the surrounding environment: in faster roads, formalised information like place names, road numbers and junction numbers are considered more suitable; in urban roads drivers perceive a higher need for informal and context-based information. Additionally, voice messages are seen as an advantage but always combined with the visual instructions because it is proven that visual messages can be more adequate to explain complex situations.

Regarding the interaction with MP, personal benefits have been reported [3] [8]. Its use is seen as a way of preventing unnecessary trips; diminishing the tendency to speed specially when a person is running late; contributing to safety and peace of mind (particularly when someone is lost); improving mental alertness in case of long and monotonous drive; contributing to have more time at home as some phone calls can be made while driving instead of at the office; and also increasing coordination of social engagements. Different factors can influence MP use while driving [9]. A study from White et al. [10] has reported that considerable percentages of drivers use it while driving, and despite this

extent of use varying among owners, a considerable percentage of drivers use it on most of their trips. Hazardous situations or even accidents were also reported due to the interaction with such technology [11].

2 OBJECTIVE

This paper presents the methodology and results from focus group interviews, conducted within the framework of the INTERACTION project. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n°218560. The main aim of this European project is to study four different systems (cruise control, speed limiter, navigation system and mobile phone) and to identify the patterns of use of these IVT by drivers in everyday life. The first research phase of this project implied the conduction of planned focus group interviews with the main aim of collecting drivers' perceptions in this specific area of interest.

The described focus group aimed at understanding why, when, where and how drivers interact with the above-referred IVT. It was also proposed to find out how drivers recognise the support and effectiveness supplied by these systems, and whether they consider the systems are providing the expected assistance. Gathering such information was also important in understanding more about the moments and modalities the drivers choose to interact with IVT, in order to help researchers to structure the cross-country questionnaire-based survey as well as the naturalistic and in-depth driving behaviour studies that will be conducted in subsequent phases of this project.

3 METHOD

3.1 Focus group sessions

Among the four IVT selected to be studied in the INTERACTION project, two were belonging to the advanced driver assistance system group (Cruise Control and Speed Limiter) and two to the in-vehicle information and communication technologies (nomadic Navigation System and Mobile Phone). The focus group sessions were conducted in five different European countries (Austria, Finland, France, Portugal and Spain), and the same methodology was applied in every country. Each focus group session promoted the discussion on two IVT: CC and SL, or NS and MP.

The sessions were led by a moderator and an assistant, and lasted from two to three hours. In the first half of the session one system was under discussion, and in the second half the participants were encouraged to give their opinions regarding the second device. Each session was carried out with 5 to 8 participants.

All session started by welcoming participants and by giving introductory information about the study. Participants' filled questionnaires giving information regarding their demographic characteristics, driving experience, travel patterns and general use of the systems. A photo presentation (on cards or sheets of paper) was also showed before each discussion to briefly remind the main system functions and to avoid any confusion between the devices during the

discussion.

During the discussion, questions were launched by the moderator who followed a discussion guide that was equal in each country. The key issues covered on the discussion guide intended to collect information on the way drivers interact with the systems: why, where, when and how. The objective was also allowing all participants to be involved in the discussion and to recall important details of this interaction. The moderator encouraged participants to express some critical and unexpected situations they had already experienced, as well as moments where they felt the need to override the system functions or to use it for other purposes.

In order to analyse the data collected, researchers took into account that focus groups consist in a qualitative survey technique, which is often used as a preparation for a quantitative research. The collected outputs must not be considered as representative of a population but give an overview about different opinions, attitudes and arguments regarding a topic. The aim was to gather more information and a broader view about all different aspects, which could also include contrary statements of the participants. The distribution of the opinions and the patterns of use of the four discussed IVT within the population of drivers will be quantitatively evaluated within the INTERACTION project by a standardised questionnaire (representative sample of 1000/country) and by different observation methods.

3.2 Test participants

Three groups of drivers of different ages and with different driving experiences were selected to take part in the focus group sessions: young, standard and experienced drivers. These groups were selected with the objective of collecting a broader spectrum of opinions from drivers with different characteristics.

A total of 133 drivers (44 females and 89 males) participated in the focus group sessions held in the five different countries: 33 belonged to the experienced drivers' group, 44 to the standard, and 53 to the young drivers group. Results presented in this paper illustrate the opinions collected in the CC & SL focus group sessions conducted in Austria, France, Portugal, and Spain, while the NS & MP results are the product of the opinions collected in the sessions conducted in Finland, Austria, and Portugal. Sessions were carried out for the three driver groups. The final composition of the sample is displayed in table 1.

Table.1. Composition of the sample for the focus group sessions

	CC and SL Sessions					NS and MP sessions					
	Nr	Mean age	SD age	Male	Female	N r.	Mean age	SD age	Male	Female	
Experienced	22	45,5	8,9	21	1	4	40,7	8,3	13	1	
Standard	26	40,5	5,6	16	10	1	8	37,8	5,9	6	12
Young	30	23,3	4,0	20	10	2	3	22,8	1,7	13	10

Regarding the driving experience, the young participants had one to five years of driving experience and had driven more than 10000 km the preceding year. Standard drivers had more than 10 years of driving licence and had driven 10000 to 20000 km last year. Experienced drivers had obtained their driving licence at least 10 years ago and their driving experience was different from standard drivers as they had driven at least 30000 km during the past year. All participants had the above-referred IVT for at least one year.

4 RESULTS

The following results show the opinions expressed by participants from the 3 drivers groups during the focus group discussion. Results will be presented by each in-vehicle system.

4.1.1 Cruise Control

In what concerns the interaction with the CC all driver groups referred to highways as the roads where they usually use the system. Nevertheless, other types of roads were also mentioned by some participants like freeways or urban roads. The conditions mentioned as being important for the drivers to use the system were: straight roads, road without stops, and roads with light traffic. Participants mentioned also to activate CC for big trips, when travelling at high speeds, when travelling at night or in familiar courses. The use of CC appeared also to be influenced by the presence or absence of passengers as some drivers mentioned using it when passengers are present (to satisfy their request to travel at moderate speed) or only when they were alone (because the passenger does not feel safe when the system is activated).

The drivers' internal state contributes to the activation of the system. Some participants declared that they use it when in the mood to do it, or when they feel tired and need to do a more relaxed driving. On the other hand, other participants mentioned avoiding using it when they feel tired or sleepy because it turns the driving activity more monotonous. Heavy traffic, urban areas, roads with curves and hilly roads seem to be the situations where respondents in all groups usually avoid using the CC. Bad weather conditions and driving at night seem also to persuade some drivers not to activate the system. Situations where the driver does not feel comfortable because he/she considers that is a dangerous situation or requires being more attentive than usual are also situations mentioned as avoided.

The participants affirmed choosing the speed to set the system according to the traffic situation, the presence of radars, the speed limits and their own rush. However, some of them admitted using the same speed as the legal limit while others selected a higher one. Some drivers even mentioned to set systematically 10% more than the legal limit justifying this action by the lack of accuracy of the speedometer. Certain drivers declared using the speed information given by the Navigation System as they suppose it can be more accurate. Drivers also affirmed travelling generally beyond the 10% speed increase. Moreover, in the four countries some participants stated using CC as a fun factor. They declared using the "+" and "-" buttons to augment or reduce the set speed as a way of substituting the gas and the brake pedals.

When the CC is activated participants affirmed feeling more relaxed. Some stated to put the feet close to the pedals to be ready to brake, others place them far from the pedals, crossed, or on specific feet supports built in the car. Moreover, one driver declared taking the shoes off while the system was active. Besides these answers revealing that the driver's behaviour can be different, some participants stated that they do not change their behaviour and habits while using CC.

The most frequently mentioned advantages provided by the system were the physical and mental comfort, the increased safety, the reduction in fuel consumption, and the possibility to avoid speeding penalties. The attention loss towards the driving task and the drowsiness were mentioned as disadvantages by almost all the groups. Drivers also affirmed that the time to react to an emergency situation could be higher when the foot is away from the pedal. One driver even mentioned an episode where he pressed the clutch instead of the brake when bringing back the foot to the pedals. The loss of control feeling and the sensation that in some situations the car is driving too fast according to the road characteristics (as in sharp bends) was also referred to as being drawbacks. Moreover, some drivers considered that CC does not contribute to augment the safety and may also increase the fuel consumption. Finally, the possibility of a system malfunction appeared to worry certain drivers.

4.1.2 Speed Limiter

Almost all the groups that participated in the sessions stated that SL is generally used in urban areas and areas with speed controls. Fewer drivers mentioned using the system in rural areas and highways. Some subjects also declared to activate the SL when the traffic is heavy, or when travelling in long stretches of the road with the same speed limit.

In two groups drivers affirmed that they do not like to use the SL and they do not feel the need to use it. Many drivers affirmed that the CC can substitute the SL. While using the SL they stated to feel like losing control, believing also that there is no increase in safety.

To choose the speed, drivers in all the countries declared setting the same speed as the speed limit. Nevertheless, other drivers also mentioned having already activated the SL a bit above the legal limit or about 1 km/h below. Drivers using the system on the highways affirmed to set the speed to a higher speed than the legal limit, and this value is the one from which the penalties change from light to severe.

The main advantage of using the SL was identified as the reduction of the possibility of getting a speed fine. Drivers considered that the system also avoids driving too fast due to distraction and that it contributes to be more concentrated on the road. The main disadvantages were related with the difficulties in operating the emergency deactivation. Many drivers considered that in some moments there might be the need to accelerate and exceed the set speed, which was identified as a difficult action. In all countries there were drivers who did not know or did not use this kick-down-function. The ones that used it affirmed to consider it not reasonable and also dangerous. Certain participants expressed the opinion that SL was frustrating, had no advantages,

and demand more effort to the driver.

4.1.3 Navigation System

In a unanimous way drivers declared using the NS to find unknown destinations. Participants also stated using it for holidays and for travelling abroad. The system is generally seen as an orientation aid and can be a continuous companion even in case of familiar trips. Some drivers also reported that they use it to find alternative courses to reach a familiar destination. However, in the majority of the groups drivers stated not using the NS for well known trips. Some participants refuse to use it because they do not like it or because they prefer using other media (like maps). Other motives were mentioned for not using the system in particular situations: when the information on the system is not updated, while in the city and the traffic is congested, and in leisure trips.

When entering a destination all groups mentioned the use of a complete address to get guidance instructions from the system. Additionally, some drivers mentioned that they also use the points-of-interest, a reference point near the place they are travelling to, or even the coordinates. Participants in all groups affirmed that they enter the destination before starting the trip, while driving or during the trip when the car is stopped.

In what concerns the output information, some drivers affirmed using the information of the visual display only. They stated that this visual information can be useful to anticipate the design of the road ahead and to confirm the information provided by the NS vocals. Nevertheless, participants in all groups declared using the visual and the vocal instructions for guidance. Regarding the privileged information obtained from the NS, the speed limit, the radar warnings, as well as information concerning the destination (like the time or distance to reach it) seemed to be the most frequently mentioned ones. Maps, 3D images and specific instructions to the next action were also mentioned as important.

The main advantages of the NS were mentioned in terms of guidance support and comfort for the driver. The NS can be especially useful to find important points in emergency situations. It helps drivers to plan the route in a more efficient way and can give other important information like the speed limit or the places where the radars are, which was frequently mentioned. Some drivers stated that using the NS can improve the driving activity because it avoids hesitant driving when the routes are not familiar. The fact of being portable is also an advantage as it can be used in different cars or even in other modes of transport.

Additionally some disadvantages were also reported. Participants in almost all groups affirmed that contradictory, not clear, wrong or not updated information can definitely be a drawback. Some aspects related with the handling and with the output transmitted were also mentioned, like the sounds that are not pleasant, the size of the display, or instable connection with the satellites. Another aspect mentioned was the dependency that the system created as it may delay or hold back the road memorisation and learning. Distraction was also mentioned by the majority of the drivers groups as a negative effect.

Some participants in the focus group affirmed to interact with the NS for different purposes like listen to music, watch movies and to connect this device with the mobile phone.

4.1.4 Mobile Phone

Regarding the interaction with MP, drivers in all groups affirmed using it when there is an incoming call. Some declared that answering the call may depend on who is calling and whether it is safe or not to do it. Answering the call while the car is stopped at a traffic signal or while parked is an option for some participants. Others mentioned that their call duration is generally very short. Participants also affirmed that the interaction with this equipment is frequently made during long trips or in rural roads. Making calls is also something done by the participants, especially in case of emergency and urgent situations.

Drivers stated not to use the MP when they need concentration, when they drive in unfamiliar roads, in cities with high traffic density, or when the police is near. Some affirmed to avoid answering a call when they have the opportunity of having the conversation later or when they are reaching their destination. Calls that are previewed to be related with business, to be long, emotional or very difficult are also avoided sometimes.

Regarding text messages, while some drivers stated that they do not read or write text messages while driving, some other participants affirmed doing it. Nevertheless, in all groups drivers mentioned that they usually do it while the car is stopped or when the traffic situation is not difficult.

It was verified that passengers often influence the way drivers interact with their MP. Participants in almost all groups affirmed that passengers can help them to interact with it, by taking the call, reading the message, or even holding the MP near the ear of the driver. For a few drivers the presence of passengers has no influence in their way of using MP, while for others it could restraint them to answer a call.

In a general way, drivers considered that using a MP while driving have some advantages: it is crucial for emergency situations, to reach somebody and to inform about a late arrival or to ask for instructions about the best way to reach a destination. Using the MP is seen as a way to utilise efficiently the time, rendering possible to change schedules and to reduce unnecessary trips. Participants also stated that MP can help drivers to stay awake during a monotonous trip, and gives the possibility of performing other activities like listening to some music or access the internet.

The disadvantage the more frequently mentioned was the distraction factor. Other drawbacks were related with some forms of interaction with MP which are forbidden (hand-held), bad connections that sometimes obstructs communication, and the difficulties that this task imposes to driving. Some participants mentioned also another negative aspect related with some interlocutors' expectations that the driver has to answer the call even while driving.

5 DISCUSSION

Considering CC and SL results, it can be affirmed that drivers use these systems according to the situational context, aspect which is in line with the AIDE project findings reported earlier in this paper. CC is frequently used on highways, being the road design and the traffic conditions important factors for using it or not. This result is also consistent with those from previous Australian research [3]. On the other hand, it seems that SL is used more frequently in urban areas and roads with speed controls. However, negative attitudes were often seen towards SL as some drivers mentioned not using it at all. Additionally, the opinions expressed by some participants that CC may substitute the functions of SL associated with a clear preference in using this system instead of the SL, lead researchers to suppose that CC is used more frequently by many drivers that have both systems in the car. Regarding the speed set, the comparison between CC and SL showed that higher speeds are used with CC, confirming also a superior distance from the legal limit. Speeds used for SL were presented as closer and more related with the legal limit imposed to the current stretch of the road. This aspect is related with the advantages reported on the systems and is in line with previous findings [3]: CC is more linked with comfort and SL with the speed control. Furthermore, more changes to the normal driving behaviour were identified when using the CC. Its activation leads drivers to feel more relaxed, being the position of their feet and legs potentially different than when the system is not activated. Inversely, drivers affirmed that using the SL do not induce changes on their behaviour. The main disadvantages reported were related with the CC contribution to monotonous driving and also with a feeling that the set speed may not be adequate to all the situations encountered on the road. The drawbacks regarding SL were related with the need to exceed the set speed in an emergency situation. These findings are related with the ones from the AIDE project as some negative aspect pointed out by the drivers can be related with loss of control sensation.

NS users confirmed previous findings that they use the system for travelling to unfamiliar places, for getting assistance in guidance and also for finding alternative ways in familiar paths. However, additional information was reported in this research regarding the moments that drivers avoid to use this equipment. Not using the system depends on the context, as some participants reported that they switch it off when travelling in familiar areas. Furthermore, it depends on the accuracy of the information: when the information becomes confusing or is not updated drivers affirmed to disconnect it. Results also showed that several strategies are used to enter a destination, which can be done before or while driving. Both visual and voice outputs are important for drivers, even if some of them affirmed using the visual information only. They confirmed the previous finding stating that visual information can be extremely helpful in complex situations [3], but present another utility as they also use it to anticipate the design of the road ahead. Furthermore, the indication of time and kilometres needed to reach the destination, distance to the next manoeuvre, and also the indication of the current speed limit are cited as examples of important information used during a trip, which can probably justify the fact that some drivers use the system all the time, even when the area is familiar.

In what concerns MP, answers given by participants indicated that the interaction with this equipment is not uniquely dependent on the situational context. Even if they recognized that one of the main disadvantages of using it is the distraction imposed to the driving activity, most drivers affirmed to answer a call depending first on who is calling. The context may be a restraint when drivers feel the need for being more attentive and concentrated, when driving in unfamiliar roads and in cities when the traffic is dense, showing that avoiding to use MP can be somehow dependent of their sense of control towards the situation. Drivers also stated that they avoid using MP when the police are around. Knowing that in all the countries where the focus groups were conducted only the hands-held situation induce to a penalty, researchers may conclude that either drivers do not know the law in detail or do not use frequently a hands-free system. Another result could confirm it as a large group of participants stated that the presence of passengers influence the way they interact with MP, as passengers represent a help for this interaction, which would not be needed if they were using a hand-free MP. On the other hand, passengers are also considered to work as a fact of restraint, especially when the topic of the phone conversation needs to be maintained undisclosed.

Finally, the results obtained in these focus groups led researchers to conclude that different types of systems are used in distinct ways among users. The expressed opinions can indicate that the motives linked with the utilisation of a system may not be exclusively dependent on safety issues, but also on comfort, personal motives, and efficiency brought to the driving task. The use of systems that can somehow restrain the actions of the driver or represent a loss of control over a specific driving function seems to be seen as a disadvantage and even considered to be dangerous in particular situations. It was also clear that drivers know the basic functions of a system, i.e. the ones that are needed to get it working, but may not know all the possibilities of its use. In general terms, participants recognized that the interaction/activation of the systems in certain moments may influence negatively the driving task. However, some admitted to use it even when the safety conditions are not totally assured.

Furthermore, the results collected in the focus groups will help researchers to design further experimentation moments such as naturalistic and in-depth driving behaviour observations. Once known the pattern of use of systems, it will be possible to select in a more accurate way the type of drivers that will have to take part in following experimentation moments. On the other hand, this knowledge will allow to better define methodological strategies to capture a broader spectrum of moments to analyse, especially the ones that may show an unexpected and unattended use of the system.

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