Exploring the driver instructor metaphor
Requirement assessment for an advanced driver assistance system that provides driving related feedback

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Abstract
The risk of being involved in a traffic car accident increases with age. Countermeasures such as advanced driver assistance system and retraining programs have both been ways of trying to reverse this trend. This thesis sought to merge the two countermeasures by exploring the idea of a system that gives feedback on elders’ driving. Two separate requirement assessments were carried out with the aims to address what, when and how feedback should be communicated to elderly drivers. Additional aims were to assess requirements that could affect the acceptance and trust in relation to the system. Firstly, a literature review assessed requirements based on preexisting knowledge in relevant domains. Secondly, focus group interviews with driver instructors and elderly drivers were performed to assess requirements in relation to the specific system idea. The results reveal several requirements that could serve as input to the design of the system. The results and their possible implications are discussed.
Introduction

Most countries of the world are facing an ageing population (United Nations, 2010). In the western world, Europe will in the coming decades experience a high number of ageing baby boomers turning into elderly persons, defined here as people who are 65 years or older. It is projected that the population aged 65 or over is going to increase from 17.1 % in 2008, to 23.5 % in 2030 (Giannakouris, 2010). Sweden is no exception to this trend, where 22.3 % of the population is projected to be 65 years or older year 2030, compared to 18.4 % year 2010 (Statistiska Centralbyrån, 2014).

As the population grows older, so does its licensed car drivers. At first glance it might therefore feel comforting to know that drivers that are 70 years and older have lower rates of police-reported fatal crashes per capita, compared to younger drivers. On a closer look however, both crashes and fatal crash rates per distance travelled follows the same curve and increases noticeably for drivers 70 and older (Figure 1). Especially, the proportion of crashes in intersections increase steadily and is the most common traffic context for incidents with severe outcomes amongst elderly drivers (Insurance Institute for Highway Safety, 2013). Taken together, data shows that drivers are getting older and that driving in intersections poses a particular serious risk for older drivers. This accident pattern is the same throughout the western world, including Sweden (Trafikanalyse, 2013).

![Figure 1. Fatal crashes per 161 million kilometers travelled, by driver age (Insurance Institute for Highway Safety, 2013).](image)

Older drivers is a heterogeneous group of people and the reasons leading up to accidents are probably numerous. While the rate of fatal victims is related to a higher physical vulnerability (Viano et al., 1990), the rate of accident involvement is generally the result of a combination of contributing factors (Broberg, Jakobsson & Isaksson-Hellman, 2008). Cognitive and physical changes over the years can all play a role in affecting older people’s driving behavior (Koppel, Charlton, & Fildes, 2009). Eventually, these types of changes in the driver might lead to a higher risk of being involved in accidents (Edby & Molnar, 2009).

Elderly drivers generally adapt to gradual changes in their bodies and brains by avoiding certain types of traffic contexts and may for instance choose to drive more slowly. However, a lack of self-regulation
(i.e. adaption) can lead to far too small safety margins, given that the task demands are high relative to one’s driving ability (Kuiken & Twisk, 2001). Indeed it seems that some elders fail to self-regulate their driving according to what they are capable of coping with (Lallemand et al., 2013). Why might this be? Well, one answer is that the need of balancing task demand according to one’s ability might not always be obvious. Drivers seldom experience the negative consequences that driving with small safety margins can have. It is for example common for people to drive at excessive speed, but the behavior rarely result in any accident. Consequently, normal driving might lead to a cradle belief that one’s ability to drive safely\(^1\) is in line with the task demands. As McKenna (1982) notes, driving is notoriously forgiving, providing great scope for error recovery, while supplying road users with the minimum of feedback on their driving performance.

For decades countermeasures have been initiated and researched for reducing accident involvement. Amongst these measures are advanced driver assistance systems (ADAS). These systems are designed to support or automate the tasks that constitute driving. Some tries to help the driver by providing decision support in complex traffic scenarios, such as intersections (e.g., Daimon & Kawashima, 2003; Dotzauer et al., 2014). Others warn the driver about impending threats in relation to the car (e.g. Nodine et al., 2001). Usually these systems serve their purpose by trying to prevent the driver from getting involved in dangerous situations by warnings and automatic brakes. Few systems tries to change the drivers own behavior into a safer one by improving driving performance. Assumingly, such an ADAS could help the driver to avoid ending up in unpleasant situations in the first place - situations where numerous of today’s systems play their role.

Another type of countermeasure is retraining programs designed for older drivers (Peters et al., 2013). It is argued that retraining initiatives could help elderly drivers achieve better awareness of their driving ability, and furthermore serve to improve driving performance (Broberg & Willstrand, 2014). A study by Poschadel (in press) has shown promising effects when using driver instructors (DIs) to improve driving. By providing feedback, the study showed that elderlies driving performance could be improved to the point where it was comparable with that of a middle-aged group. As a principal, feedback can be described as information provided by an agent (e.g., a teacher or technology) regarding aspects of one’s performance (Hattie & Timperley, 2007).

By adopting the role of a DI that gives feedback, an ADAS could help to improve elderly persons’ driving performance. Let us look at an example to concretize:

Uncle George has been driving half his life. With age, his neck has become gradually stiffer, his reaction time slower (age-related declines), and without noticing (lack of feedback), he has slowly started to look less to the sides while driving through intersections, and he also does this in such a speed that the safety margins are too small if something was to happen (poor driving performance). A feedback system tells him that the driving behavior is incorrect; he needs to slow down and start looking for traffic coming from the sides (feedback). He takes notice (self-assessment) and next time he is out driving, he slows down (self-regulates the driving task according to his abilities) to create the time needed for looking to the sides before driving through intersections (correcting erroneous behavior), making his driving safer (improved driving performance).

What appropriate feedback to elderly experienced drivers consists of, and when it should be given, is yet to be studied. Neither is it known what the most appropriate medium(s) to communicate the

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\(^1\) Good and safe driving performance is the ability to drive according to the rules of the road and be able to avoid the risk of collision by anticipating dangerous situations, despite adverse conditions or the mistakes of others (ANSI/ASSE, 2012).
information might be and whether such a system would reach acceptance and trust amongst elderly drivers.

Objective
Technological progressions make different kinds of ADASs possible and feedback is one way to improve driving performance. Consequently, the overall objective of this thesis is to explore how the DI as a metaphor can be integrated in the car to form an ADAS that gives driving related feedback. Such an ADAS could presumably help to improve elders’ driving performance.

Specifically, this thesis aims to inform the design of the ADAS by assessing requirements\(^2\) regarding what, when and how feedback should be communicated to elderly drivers. Additional aims are to assess requirements that could affect the acceptance and trust in relation to the ADAS. These requirements will be assessed by using a literature review and focus group methodology. They will provide input to the development of an ADAS demonstrator within the SAFEMOVE project. The main objective of the SAFEMOVE project is to promote safe mobility for older drivers (Peters et al., 2013).

To make things clear, when referring to the ADAS in this thesis, it is about something that only exists as an idea. No technological artifact will be built nor evaluated in the scope of this thesis.

Structure of this thesis
Coming up next, the literature review chapter starts by describing the method that was used. It then goes on by presenting the results that ends with a table containing the assessed requirements from the reviewed literature. The subsequent focus group chapter also starts off by describing used method. As with the literature review, the chapter thereafter presents the results and ends with a table containing assessed requirements. Finally, the thesis finishes with a discussion concerning requirements and implications, methodological limitations and some final remarks.

\(^2\) Requirements, sometimes known as needs, are things that users wants the system to be able to do or a quality it ought to have (Benyon, 2010).
Literature review
The idea of an ADAS that provide driving related feedback to elderly drivers is novel in the sense that no published research seems to exist on the subject matter. But research on elderly drivers and the notion of driving related feedback is nothing new. Consequently, the author did a literature review in different but related domains to assess requirements that could be reused. A literature review is an analysis of relevant available research on the topic being studied (Cronin, Ryan & Coughlan, 2008). It is a commonly used method when assessing requirements (Zhang, 2007).

Method
Sources
Numeral sources were used in the literature review. Internet searches were initiated by using Google Scholar, which subsequently resulted in articles from different databases, selected independent of time period. For papers regarding age-related changes and the effects on driving, the following databases contained papers of relevance: APA PsycNET, Taylor & Francis, SafetyLit, ScienceDirect, CiteSeerX, ITRD, IATSS, SAGE journals, Wiley Online Library, DiVA.

Librarians and researcher Björn Peters were consulted at the Swedish National Road and Transport Research Institute’s (VTI) head office for references concerning DIIs and elderly driver training. For research on intelligent tutoring systems, a field where tries had been made to automate the driver instructor, the following databases contained relevant research: ACM, UTpublications.


Analysis
The reviewed literature was first synthesized into comprehensive read. A requirement assessment was thereafter performed on the material, a process known as “requirement reuse” (Zhang, 2007), where preexisting requirements are used in a new area. The resulting requirements were based on the analysis of research on age-related changes, DI literature and lessons learned in the research field of intelligent tutoring systems. They were sorted depending on their relevance for the different aspects of the ADAS (Table 1). In general, literature concerning the DI and the use of feedback provided requirements about what and when to communicate. Research about age-related changes provided requirements about how feedback should be communicated. Literature on intelligent tutoring systems provided requirements regarding factors that could influence acceptance and trust. Trust defined here as the attitude that a system will help achieve an individual’s goals (Lee & See, 2004), and acceptance as the individual’s direct attitude towards a system (Ven der Laan, Heino and De Waard, 1997).
Table 1. Explanation of the aspects that the assessed requirements were divided into.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Explanation</th>
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<tr>
<td>What to communicate</td>
<td>What the feedback messages should be constituted of.</td>
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<td>When to communicate</td>
<td>When the feedback messages should be communicated.</td>
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<tr>
<td>How to communicate</td>
<td>How the feedback messages should be communicated.</td>
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<tr>
<td>Trust</td>
<td>Factors that might affect the trust in the ADAS idea.</td>
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<tr>
<td>Acceptance</td>
<td>Factors that might affect the acceptance in the ADAS idea.</td>
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Results

Elderly drivers

With time, changes in a person’s body may slowly reshape the ability to drive. Declining eyesight and hearing makes it harder to perceive what is going on in an increasingly hectic traffic environment. And while the neck gradually becomes stiffer, making it harder to look to the sides in intersections, new traffic rules may be passed that were not there when the elderly driver took the drivers’ license. People generally adapt to ongoing changes. However, a stiffer neck and eyesight does not happen overnight, and some might fail to become aware of their declines and how these in turn affect the ability to drive.

The regulations of driving according to one’s capabilities is crucial for continuing to drive in a safe manner and for reducing accident risk (Peters et al., 2013). There are evidences that this might not always be the case; some people keep on driving as always without regarding how their capabilities have changed over the years. On the other side of the spectrum, some gradually mistrust their ability and starts to avoid certain situations or stop driving altogether (Lallemand et al., 2013).

With the heterogenetic nature of elderly drivers in mind, age per se is not regarded as a good predictor of driving performance. But, aging is frequently associated with some level of non-pathological declines in sensory, physical and cognitive capabilities (Koppel et al., 2009). These functional declines can in turn affect driving performance for the worse, possibly leading to a higher risk of being involved in accidents. This is why efforts to help older drivers maintain safe mobility needs to be based on an understanding of the abilities that can decline with age and also on how these in turn might affect the ability to drive (Edby & Molnar, 2009).

Visual perception is regarded as the primary source of sensory input during driving (Sivak, 1996). This is to say that our vision is highly involved in the process of driving a car in traffic. The performance of this sense tends to decrease with age (Forzard, 1990), and might be one of the factors involved in leading up to a traffic accident. Functions such as peripheral vision, contrast sensitivity, glare sensitivity, motion perception, and visual acuity are amongst those affected by aging in a declining manner, as studies have shown (e.g., Brug, 1968; Rubin et al., 1997; Rogé et al., 2004). To make these declines concrete in this context, imagine driving in a complex scenario without being able to notice objects in motion coming from the periphery. Imagine having an even harder time perceiving traffic scenery in low-light conditions or having trouble distinguishing objects from each other because of low contrast differences. Imagine being even more sensitive to glare from meeting cars in the dark, or not being able to accurately judge their motion, and in general seeing things blurrier than before. Imagine
not being able to perceive what is being communicated through a graphically based ADAS-interface with detailed text information.

Auditory perception, or simply hearing in this context, is another sense that may decline with age. Older people generally have problems with discerning voices and sounds in the extreme frequency ranges. This includes frequencies common to human speech, which can go above 4000Hz (McLaughlin & Mayhorn, 2014). Hearing is important when driving for different reasons. Being less able to hear may result in directional cues being missed and thus impairing spatial sensitivity to sound (Davidse, 2005). It has also been shown that older drivers have a harder time to filter out unwanted noises (Maycock, 1997). For example, in a scenario where the elderly driver is on a collision path with another car, he might not be able to hear a warning car horn or accurately judge from what direction the sound comes from. Another scenario, imagine not being able to focus on driving in a complex traffic situation because of disturbing noises. Hearing might also be important to perceive warnings used by ADASs in cars (McLaughlin et al., 2014). A warning system that communicates its messages via audio, e.g. a signal metaphorically saying “you are approaching a stopped car too quickly!” does not serve any function if it cannot be perceived by the intended user.

Ageing also takes its toll on the elderly driver’s physical body. Abilities that might decline as people get older are reduced joint flexibility, reduced muscular strength and reduced manual dexterity (Campbell & Streff, 1994). The decreasing ability of being able to move the head has been documented (Isler, Parsonson & Hansson, 1997; Dukic & Broberg, 2012) and might hinder the older driver’s ability to scan sceneries, such as an intersection while driving. Elderly people might also experience a declining ability to accurately judge force. For example, when performing precision tasks, they tend to over-grip. It has also been shown their response time is about one third slower than that of younger adults (Ketchman et al., 2001). As McLaughlin et al. (2014) describes, the latter decline is particularly evident when the stimulus requiring a response is unexpected. Take a time sensitive task as an example: Having to push the brakes for an unexpected car in an intersection. Physical declines in this context might lead to a situation where there is not enough time to execute necessary actions to avoid collision. Concerning the use of an ADAS, imagine not being able to accurately touch and manipulate an interface with ease.

Apart from sensory and physical declines, cognitive functioning also tends to change with age. Working memory is such a function that declines and this usually starts sometime during a person’s thirties (McLaughlin & Mayhorn, 2014). Working memory is associated with the ability to control and allocate one’s attention (Barret et al., 2004). When older persons cognitive functions declines, such as the working memory, so does their attentional resources (Koppel et al., 2009). This might have a serious impact on the driver’s ability to drive safely. Braitman et al. (2007) reported that 80 and older drivers involved in failure-to-yield crashes was predominated by looking but not seeing, i.e. they looked but was not able to attend and act on the sensory input. Braitman et al. noted that failure to see other vehicles may be due to declines in visual ability or decreased ability to process multiple sources of information simultaneously, making it harder to attend to sensory input. In line with Braitman et al.’s finding, Dukic and Broberg (2012) showed that older drivers tended to look more on traffic markings whereas younger drivers to a higher degree looked at dynamic objects in intersection situations. A follow-up study by Broberg and Willsstrand (2014) found that intersections and roundabouts were specific situations where search related errors occurred. Basically, the ability to attend to relevant sensory input declines with age and may compromise safety. Try visualizing the inability to perceive information communicated by an ADAS, because of an overwhelming amount of information trying to grab one’s attention.

Thus far, this chapter have centered on functional age-related declines. However, other changes might also affect safe driving amongst the elderly population. For example, old people carry learned facts
and prior experiences with them. With this knowledge come prior beliefs and attitudes that are not easily changed (McLaughlin & Mayhorn, 2014). The traffic context might have changed a lot since old drivers got their driver’s license. As reported in Stave et al., (2014), new traffic rules, new road signs, and an overall faster and denser traffic might be factors, apart from age-related declines, affecting safe mobility. For instance, some elders might have difficulties in accepting that the car no longer has priority over pedestrians and cyclists in certain situations. Concerning the use of ADAS, elderly drivers have shown attitudes of resistance against new technology because of it needed to be learned to be useful. There have also been assumptions of it being expensive and fragile since it is electronics (Stave et al., 2014).

People’s awareness of how their abilities gradually change differs between individuals. Being aware of ones limitations leads to an adaptive behavior, such as driving at lower speeds and avoiding certain types of situations. While older drivers in general presumably adjust their driving adequately to accommodate for these changes, it is possible that some fail to self-regulate (Charlton et al., 2006). This might compromise safety since that a correct estimation of one’s driving ability is necessary to drive safely (Peters et al., 2013). If a driver does not balance the driving according to his abilities, he can be sorted as either an over or under estimator. In this context, an over estimator is a person who thinks too high of his driving performance, which may lead to safety being compromised in situations he thinks he can handle but in reality cannot cope with (De Craen et al., 2007). On the other hand, an under estimator is a driver who thinks of his driving performance as poor, which can result in a lack of willingness to drive and premature driving cessation (Siren & Meng, 2013). To date, there does not seem to exist any reliable estimates on the percentage of drivers that fits in these two groups. However, by using different methodologies, several studies have aimed at identifying them.

Lallemant et al., (2013) carried out a study to investigate statistical relations between situations drivers thought were difficult and situations were accidents actually occurred. The results showed that there were some situations that tended to be more problematic than others. Accidents were frequent in intersections, especially left turn maneuvers, and on high-speed roads, especially merging and overtaking. As they also measured elderly people’s confidence in relation to these situations, it could be shown that some drivers, mostly men, did not perceive these types of situations as difficult, consequently not avoiding them. Another finding was that situations that directly could be perceived as difficult, due to declines in sensory abilities, tended to be avoided by both women and men. This included situations such as driving in bad weather or at night. Lallemant et al. concluded that some driver’s might over estimate their own driving ability, thus exploiting themselves to situations exceeding their actual driving performance. Conversely, some drivers seemed to under estimate their ability to drive, leading to avoidance of certain situations or a cessation of driving all together.

Under and over estimators were also identified in a study by Broberg and Willstrand (2014). The study used a driving instructor and an occupational therapist to assess the elderlies’ driving performance on a fixed route in a city environment. As the drivers themselves also assessed their driving, they could be sorted into different estimator categories. Common mistakes made by the drivers were not adapting their speed and not putting enough attention to the traffic in intersections. After each driving session, the drivers were provided with feedback about their performance. The participants easily accepting the feedback could be found amongst the adequate and under estimators. The over estimators on the other hand found other factors to blame, such as the surrounding traffic and the need to stay in “traffic flow”. To counteract the tendencies of not self-regulating according to one’s driving ability, Broberg et al. proposed training as a way of achieving better awareness of one’s driving ability and also as a way of improving driving performance.
Driver training indeed seem to be one way of helping the driver in the self-regulation process. Groeger and Grande (1996) studied the relationship between self-assessed and DI assessed driving performance. It was shown that middle-aged drivers’ view of their own driving was only weakly related to the DI assessment. Without explicit DI feedback, the drivers’ self-assessment was more positive than that of the DI. Whereas with feedback, the assessments were related. Thus the feedback coming from the DI served to help the drivers to assess their own driving performance. One concrete example on how feedback serves the self-regulation process can be found in Hassan, King and Watt (2015), where elderly drivers were interviewed about the value of feedback. The following story is about a 71 years old female who took a driving test with a DI to evaluate her own driving:

“So I said, “How did I go?” He said, “Well, only two things /…/ You drive too fast and you drive too close to the vehicle in front.” And do you know what? That has helped my driving so much, just to be told that.” (p. 30, Hassan et al., 2015).

To summarize, sensory, physical and cognitive changes correlates with age and can have practical, negative impacts on one’s driving ability as well as the ability to interact with an ADAS interface. The declines can of course interact in nightmarish ways; a narrowed peripheral vision, together with a stiff neck and reduced attentional abilities makes it all the more riskier to drive safely through busy intersections. Changes in traffic and car technology since old drivers took their drivers’ license might also have negative impact on safety. Consequently, it is crucial that elderly drivers self-regulate their driving as a counter measure to their declines. While people in general adapt to their declines, some people seem to not self-regulate their driving. This might lead to a possible higher risk of being involved in accidents or to a situation where people won’t trust their own driving ability. A way of counter these tendencies might be driving related feedback, as a way of achieving better awareness of one’s driving ability and improve driving performance.

The effect of feedback
In normal driving, feedback is limited to reactions from the traffic environment. Instead of receiving feedback support, the lonely driver must extract information about the appropriateness of his behavior from the effect it has on the traffic scene. This is not always easy to do; driving seldom leads to critical situations because of the error forgiving nature of today’s traffic. Committed errors are compensated for by the design of the traffic infrastructure or other road users. This is negative in the sense that absence of feedback may over time weaken the associations between actions and their consequences. Because of weakening associations, drivers might be gradually unaware of safety aspects such as appropriate speed or vehicle positioning, leading to small safety margins once an accident scenario starts to build up (Kuiken et al., 2001).

The last time elderly drivers were exposed to detailed feedback on their driving was arguably while taking driving lessons. The DI plays a key role in transmitting road safety strategies to drivers (Bartl et al., 2005). Their tutoring is common component amongst people striving for a license, but their methods also seems to have measurable effects on older drivers’ performance (Poschadel, in press). As a professional, the DI needs to be both patient, an effective communicator and know how to use feedback to improve driving performance. This is also true when handling more experienced drivers, although the feedback techniques might need to be adjusted as these kinds of persons are not new to driving (Miller & Stacey, 2009).

Even though there are teaching programs for old drivers, such as AARP3 Driver Safety Program in USA and Car Driver 65+ in Norway, these have mainly focused on teaching theoretical aspects of traffic

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3 American Association of Retired Persons
safety. Few studies have looked into the effects of practical driver training with DIs (Peters, 2012), even if this kind of training have been sought after by elderly communities (Heikkinen et al., 2010).

An exception is a study by Poschadel (in press) that examined if driving performance could be improved by DI training in real traffic. The project, which started in 2008, was motivated by older drivers’ overrepresentation in right-of-way and left turn accidents in Germany – following a common pattern known throughout the western world. The aim of the study was to investigate whether driving performance could be improved through professional DI training in complex driving scenarios. Poschadel also wanted to investigate if the training led to a performance increase over time.

A total of 120 persons, 60 male and 60 female participants, took part in the study. 92 elderly drivers were randomly distributed in two groups. In the experimental group, 46 drivers (M = 72.6 years old) received driving training by DIs during six weeks. This was done by giving active tutoring, including feedback, while driving. In the control group, 46 drivers (M = 72.7 years old) only received feedback from DIs after each driving session. The feedback consisted of pointing out “what was good and what could be improved”. A group containing 28 middle-aged drivers (M = 44.3 years old) acted as reference group by setting a baseline for driving performance (Poschadel, in press).

To measure driving performance in each group, a version of the TRIP protocol was used. The TRIP protocol score system allows assessment of driving performance in different traffic situations with a scale reaching from 1 (excellent) to 4 (fail). Excellent driving is when a candidate performs excellently without any doubt in a situation, e.g., a very anticipatory driving style. Failed driving is when a given traffic situation has become so dangerous that the DI has to interfere (Poschadel, in press).

A route was chosen to exploit the drivers for complex traffic scenarios in Dortmund, Germany. The choice of route was based on accident data provided by the police. Taken together, the route consisted of driving through intersections and tasks such as lane changing on urban roads. All elderly subjects drove the test track four times in total and received feedback after each session. The difference between the two groups of elders was that the experimental group received 15 driving lessons between the first and second session. In addition, the driving performance of the reference group was measured at one time (Poschadel, in press). Results from the study are presented in Figure 2.

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4 Test Ride for Investigating Practical fitness-to-drive
Figure 2 shows that basically all elderly drivers benefited from the driving lessons and/or feedback. Another finding was that driving performance improved progressively over time. Relevant for this thesis, the performance improvement of the group that only received feedback was not predicted beforehand and could not be explained. Therefore, focus group studies were carried out to try understand how only feedback could have such impact on driving performance. 10 elderly persons participated in the interview and reported that the feedback had been incorporated in their driving routine; they had started to correct their driving according to the feedback that was given to them. By some, it was also described that they had started to be more attentive and concentrated in traffic after participating in the study (Poschadel, in press).

To summarize, a group of elderly drivers participated in a study where they were exposed to feedback on their driving. The feedback they received, communicated at four sessions spread over 14 months, improved their mean driving performance to the point where it was comparable to drivers in the baseline group containing middle-aged drivers. Research shows then, that feedback can improve elderly drivers’ performance. Alas, driving related feedback coming from a DI is rare in people’s lives.

The driver instructor
The DI is regarded as a key person in transmitting road safety strategies and attitudes to drivers. By instructing what to do, interfering when needed and providing feedback, the DI strive to maintain and teach people safe driving. The use of feedback is one of the most crucial tools for this purpose, enabling the possibility to correct erroneous driving behavior (Bartl et al., 2005). Trying to describe the DI is risky business; there is not one but many exercising the profession, all with slightly different methodologies and ways of adjusting their teaching to the specific driver student and the context that they are in. With that said, a survey study carried out in UK by Silcock et al. (2000), asked almost 2000 DIs: “What makes a good DI?”. According to the results, the DI should:

- be patient, inspire confidence, tolerant, positive, good natured, sympathetic,
• be an effective communicator able to individually adapt communication methods to the client’s needs, and
• be aware of the importance of feedback.

Before turning our eyes to the DI’s use of feedback, a brief description of the first two paragraphs will follow. In *The Driving Instructor’s Handbook* (Miller & Stacey, 2009), the authors places importance in a majority of the qualities reported in Silcock et al. (2000). Regarding being patient, a DI needs to be willing to provide help, even when something has been explained several times before. By showing tolerance, pupils’ confidence will build up as well as their trust for the DI. Another way of inspire confidence is by always try to adjust driving sessions after the pupil’s driving ability, so to avoid situations where the pupil is not able to cope. It is therefore of importance to be able to anticipate the road further ahead of the pupil; the DI needs to be able to take into account any developing situation in relation to the car as a measure for keeping the pupil safe and relaxed and to avoid the unpleasant feeling of being interfered. Being able to plan as far ahead as possible, and by that anticipate any potential hazards, gives time for the DI to communicate instructions, so that the pupil can take early action to avoid ending up in problematic situations (Miller & Stacey, 2009).

Communication wise, the DI should have different ways of interact effectively with a wide variety of pupils. For reaching an effective level of communication, the DI needs to have an accurate assessment of the individual’s driving ability. Thereafter, it is recommended to find the appropriate style of communication, e.g. by adapting terminology, so that the pupil has a chance of understanding the principles that are being communicated (Miller & Stacey, 2009). Apart from the common use of verbal communication, a DI can use other mediums to interact with the driver. Drawings, pictures, movies and models can all serve to illustrate aspects that cannot be observed easily while the pupil is driving in traffic. This could be because of the pupil having the attention directed to a complex traffic situation. Or that the spatially constrained position in the driving seat makes it hard to get the overview needed for a full understanding of a given traffic situation. Illustrations serves to simplify complex scenarios and make difficult tasks understandable (Bartl et al., 2005).

Another way to communicate is by demonstrating driving behavior. By showing how things should be properly done, e.g. executing driving tasks in good coordination and in the correct order before entering an intersection, the pupil can watch and learn (Bartl et al., 2005). Another but in the literature seldom mentioned way to interact is the DI’s use of body language. If something for example has been done correctly, this might be highlighted with a “thumbs up”. If something needs to be attended to, the DI can direct the student’s attention by pointing. The DI’s use of voice, drawings, demonstrations and body language are all ways to communicate instructions and feedback to the student.

Let us now turn to feedback. Central for those practicing the DI profession is being aware of the importance of feedback and know how to use it as a tool for teaching safe driving (Silcock et al., 2000). Feedback is used not only in this teaching context but in many other teaching domains as well. As a principal, it can be described as information provided by an agent (e.g., a teacher or technology) regarding aspects of one’s performance. By providing feedback, an agent mediates “information relative to a task or performance goal, often in relation to some expected standard, to prior performance, and/or to success or failure on a specific part of the task.” (p. 89, Hattie & Timperley, 2007). In line with this description, Bartl et al. (2005) describes feedback in a DI teaching context as “a comparison between how something is and how it should be” (p. 45).

Together with instructions, feedback play a big part when teaching people safe driving. A common methodology is to first instruct the pupil where to go and what to do. The DI thereafter gives feedback on the student’s driving behavior (Hultgren, 2005). According to Miller and Stacey (2009), the feedback
message can be given at each step of an exercise or maneuver, or after an event. Short comments such as “good” or “well done” may be useful as an indication of progress. They can also play an important role as minor rebukes for errors that may have been committed, or as assistance in difficult driving situations. However, when a fault has been made, it is recommended to avoid detailed verbal corrections on the move. This applies especially if the pupil is attending to something else, such as trying to handle a complex traffic situation. But communicating incidents too late might run the risk of the pupil forgetting of them ever happening. Therefore, brief feedback messages should be given as soon as possible afterwards. This will draw attention to them, making them easier to recall if they are later referred to (Miller & Stacey, 2009).

When feedback is to be addressed in an elaborated way, this should be done when the car is parked. The feedback is recommended to contain two things: An identification of what went wrong, and a positive or neutral comment that indicates what actions that must be taken to correct the error (Miller & Stacey, 2009). Here is an example to illustrate:

**Incident:** “Our position was a little wide on the approach to the turn we just took.”

**Feedback:** “Try to position about a meter from the kerb when turning right next time.”

The amount of feedback that is communicated varies with the driver’s amount of mistakes; if he or she commits many mistakes, feedback should be given to address those mistakes in a manner that makes it possible to correct them (Miller & Stacey, 2009). A more experienced pupil, or even a licensed driver, might however not make as many mistakes as the newly introduced one. Therefore the amount of feedback might be less or of different nature in such context. Here it should be noted that this does not make feedback less relevant. As Bartl et al. (2005) notes, lack of feedback while driving can be a problem if unsafe traffic behavior passes by unnoticeably. For example, if a driver regularly drives too fast without being a subject to any corrective communication or negative consequences. This lack of feedback might signal to him that his behavior is OK, consequently leading to a higher risk of being involved in incidents. This is in line with Kuiken and Twisk (2001), stating that a lack of feedback while driving, which is usually the case after a driver gets his license, may lead to a belief that one’s driving rarely is a problem. Errors can be made regularly, but as long as feedback is not given, the driver might not perceive any incitement for changing what seems to be working. The associations between actions and the dangerous consequences they might have, weakens with every accident-free mile driven. This leads to the development of a misconception that the balance between task demands and self-assessment is rather accurate (Kuiken & Twisk, 2001).

Thus far, we have seen that the DI should be willing to always help the pupil with the driving task and be able to anticipate situations that may compromise safety. That the DI also needs to find a way to communicate effectively with the driver to be able to mediate aspects of safe driving. Feedback is central amongst the tools used by a DI. When committed faults need corrective feedback, these messages are recommended to contain information about what went wrong and how it can be solved.

One thing is teaching and giving feedback to people new to driving, another is handling experienced drivers with many miles behind the wheel. Being in a teacher role with someone from this population requires tact, diplomacy and a general adjustment of teaching methods. Some guidelines are given by Miller and Stacey (2009):

- Do not treat them as learners – treat them as equals.
- Avoid nitpicking on minor driving techniques used through the years.
- Focus learning and improvement to important areas such as planning, hazard awareness, and anticipation.
When weaknesses in style of driving are apparent, advice and give valid reasons for changing.

More feedback guidelines for DIs teaching elderly drivers in Norway comes from Hultgren (2005):

- Feedback needs to be specific as opposed to general.
- It needs to be about a faulty action and not the person that committed it.
- It should come in close temporal proximity to the fault.
- It should be welcomed - not forced upon.

Licensed drivers with experience might resent to the point where no learning or improvement takes place if he or she perceives the DI as nitpicking on their driving. One explanation to this behavior might be that the driver cannot, or will not, try to modify driving techniques that have been practiced for a long time without resulting in any incident (Miller & Stacey, 2009). That sort of argument is of course not taking into account the higher risk of being involved in accidents or other traffickers’ adjustment to one’s unsafe driving behavior. An example scenario is a driver who has been crossing hands while turning the steering wheel for 20 years, without perceiving or experiencing any problems related to that behavior. But if the airbag one day activates, a crossed arm can quickly turn into a club hitting the body and head.

Alas, a DI should not expect to be able to eradicate all faulty driving behaviors, such as “faulty” motoric memory procedures. Neither should the DI over-emphasize it. The focus should instead be on improving bigger aspects of safe driving, e.g. planning, hazard awareness, and anticipation. Those times when deviations in relation to safe driving are noted, the explanation of why the behavior is incorrect might need to be more elaborated compared to when it is given to pupils new to driving (Miller et al., 2009).

Treating the experienced driver as an equal means that the DI role needs to be adjusted to an attenuated, less governing one. This while at the same time trying to keep the professional aim of propagating safe driving behavior. Teaching experienced drivers often means that any authoritarian advantage of being older than the pupil is gone. The DI is also less likely to have driven cars for more years than the elderly driver. Not being an authority by virtue of age or experience, the DI must try to create a pedagogical environment through his subtle use of expertise and humanistic qualities (Hultgren, 2005).

All in all, the guidelines suggest that the DI needs to take on a more subtle role when teaching and giving feedback to elderly drivers. Even though the deviations to safe driving might be clear, it might not always be a good idea to communicate it. This is because it could compromise the acceptance towards the teaching DI and indirectly towards correcting faulty driving behavior.

**Intelligent tutoring systems**

Computers have been used to achieve a variety of educational goals since the early 1960s. The so called intelligent tutoring systems are designed to provide tutoring through instructions and feedback to students (Corbett, Koedinger & Anderson, 1997). And even though the systems described herein primarily are used to teach students new to driving in a controlled environment with a pre-defined problem space, they got striking similarities with the proposed ADAS described in the introduction. This is because the systems can provide the same thing: Automated feedback concerning deviations from what would be a correct task execution.

The classic intelligent tutoring system architecture consists of four components: (1) a task environment (driving in traffic), (2) a domain knowledge module (the driver instructor), (3) a student model (the driver), and (4) a pedagogical module (instructions and or feedback from the driver instructor).
(Corbett, Koedinger & Anderson, 1997). How it works: The student engages in problem solving activities in the task environment. These actions are evaluated in relation to the domain knowledge component. Finally, the pedagogical module delivers instructions and or feedback based on the evaluation of the student’s actions and on the student model.

This literature review has found two intelligent tutoring systems that have aimed at automating parts of the DI’s tasks when teaching students. Weevers et al.’s (2003) aim with the Virtual Driving Instructor (VDI) was to create system that could tutor students in different traffic situations. The simulator based VDI could conduct driver behavior analyses with respect to the driving situation and provided both instructions and feedback. As DI training involves both instructions and feedback, they studied DIs to see how these professionals carried out their work with students. The main findings were that sentences were usually positively expressed and not too long, since that would overload the student. The feedback had to be informative and explain why behavior was good or bad. It also had to be adapted to the situation and change according to the number of times it had already been provided on the same topic. In the VDI, these messages were presented by a pedagogical module that scheduled, formulated and communicated the feedback via an auditory interface. With the help of loudspeakers, messages were delivered according to their priority. Some directly, when a student’s driving behavior was regarded as dangerous. Other messages were discarded, when they were regarded as outdated. Basically, this was a ground breaking try to computer model the DI.

Most problems noted while evaluating the VDI occurred when the traffic situations were not covered by the system’s modules, and there was also a problem with the timing of feedback:

“The presence of other road users at an intersection affects the student’s behavior, but this is not taken into account by the VDI. Another problem relates to feedback timing. The VDI times events by looking at the previous context and not by looking at the expected next context. A human instructor will refrain from providing less important feedback when more important feedback possibly has to be given within a couple of seconds.” (p. 12, Weevers et al., 2003).

The first finding can be interpreted as a consequence of the VDI not knowing why the students deviated from what itself considered to be proper driving. This shows just how complex it can be for a domain knowledge module to handle deviations in relation to some norm – even in a controlled formalized simulator environment. As Weevers et al. notes, a traffic context is filled with vague, unpredictable and uncertain elements such as other road user’s intentions, which can influence behavior heavily.

Imagine a scenario in real life where a DI is tutoring one of his students. Suddenly, the student starts to slow down and the DI cannot understand why. “You should be driving in 50 km/h and not 30 km/h”, the DI tells the student. In the DI’s mind the student is clearly deviating and he therefore needs corrective feedback. In reality, the student has started to slow down to avoid colliding with an oncoming car, something that the DI has not taken into account. It is to say that if the system does not understand why deviations are happening, this might lead to irrelevant feedback messages being communicated, which in turn can compromise the trust in the system. If a user does not trust a given system, he or she might cease using it (Parasurman & Riley, 1997).

On top of the deviation problem, the second finding in Weevers et al. (2003) suggests that there is a delicate interplay between the relevance of a feedback message and the context. A system with an ambition of providing relevant feedback needs to choose the timing wisely. If the driver for example commits an error when driving through an intersection in busy traffic, this might not be convenient to communicate immediately since the driver is already putting all his attention on the driving task in a second intersection. With other words, if the system interferes in the driving task, even if the feedback
is about a legitimate deviation, this could compromise the acceptance. For a given ADAS, it is of importance that it is accepted by the driver (Van Der Laan, Heino & De Waard, 1997).

Another intelligent tutoring system is the one described in López-Garate, Lozano-Rodero & Matey (2008). This system also aimed at automating the process of giving feedback to the student during and was integrated in a truck simulator. The pedagogical module analyzed the continuous data flow coming from the driving session, and extracted those events that were regarded significant enough to communicate with the student. The system was a bit manual too considering that a DI had to choose between the feedback messages that were generated by the system. To communicate the feedback, they went with a visual interface. López-Garate et al. stated that the character of the feedback system had to be mainly dependent on its intrusiveness, i.e. amount of feedback messages given to the student: When feedback was only given as a result of a high number of error repetitions and a long time had passed since the last feedback message, this was considered as a non-intrusive behavior. On the other extreme, an intrusive behavior was when almost every mistake would be communicated. No evaluations seems to have been published regarding this intelligent tutoring system.

To summarize, the reviewed intelligent tutoring systems both targeted driver education. They used an auditory or a visual interfaces to communicate feedback with the driver. They provided feedback concerning deviations from what would be a correct task. They give an indication of possibilities and the complexity in substituting the human DI.

Assessed requirements
Table 2 contains the assessed requirements and has three columns. The left column describes what aspect of the ADAS idea that the requirement is about. The middle column contains the requirements, developed through the analysis made on the reviewed literature. The right column shows what literature the requirements stems from.

Table 2. Summary of requirements from the literature review.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Requirement</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>What to communicate</td>
<td>Elaborated feedback needs to identify what went wrong and what actions to be taken to correct it.</td>
<td>Guideline in Miller and Stacey (2009)</td>
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<td></td>
<td>Feedback needs to be specific as opposed to general.</td>
<td>Guideline in Hultgren (2005).</td>
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<td></td>
<td>Feedback needs to be about a faulty action and not the person that committed it.</td>
<td>Guideline in Hultgren (2005).</td>
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<td></td>
<td>Feedback may be about something that the driver do well.</td>
<td>Finding in Weevers et al.’s (2003) study when observing DIs. Technique used by the DIs when training a group of elderly drivers in Poschadel (in press).</td>
</tr>
<tr>
<td>When to communicate</td>
<td>Feedback may be communicated after a driving session.</td>
<td>Technique used by the DIs when training a group of elderly drivers in Poschadel (in press).</td>
</tr>
<tr>
<td></td>
<td>Feedback may be communicated at each step of an exercise or maneuver, or after an event.</td>
<td>Guideline in Miller and Stacey (2009). Short comments may be useful as an indication of progress, or minor rebukes for errors that may have been committed, or as assistance in difficult driving situations.</td>
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<tr>
<td>Detailed verbal feedback needs to be avoided while driving.</td>
<td>Guideline in Miller and Stacey (2009). Detailed feedback should be given when the car is parked.</td>
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<td>-------------------------------------------------------------</td>
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<tr>
<td>Verbal feedback needs to be communicated in close proximity to the error.</td>
<td>Communicating incidents too late run the risk of the driver forgetting of them ever happening. Therefore, brief feedback messages should be given as soon as possible afterwards. This will draw attention to them, making them easier to recall if they are later referred to (Hultgren, 2005; Miller &amp; Stacey, 2009).</td>
<td></td>
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<tr>
<td>Feedback needs to be adapted to the situation.</td>
<td>Reported in Weevers et al. (2003). For example: Directly, when driving behavior is regarded as dangerous. Not at all, when outdated or when it possibly interferes with an ongoing task.</td>
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<tr>
<td>Level of intrusiveness needs to be considered.</td>
<td>A non-intrusive behavior is when feedback is given as a result of a high number of error repetitions and a long time has passed since the last message. On the other extreme, an intrusive behavior is when almost every mistake is communicated directly (López-Garate et al, 2008).</td>
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</table>

**How to communicate**

<p>| The interface needs to take sensory, physical and cognitive declines into account. | Age-related declines to consider: Peripheral vision, contrast sensitivity, glare sensitivity, motion perception, and visual acuity (e.g., Brug, 1968; Rubin et al., 1997; Rogé et al., 2004). Auditory perception (McLaughlin &amp; Mayhorn, 2014). Joint flexibility, reduced muscular strength and reduced manual dexterity, stiffness (Campbell &amp; Steff, 1994; Dukic &amp; Broberg, 2012). Response time (Ketchman et al., 2001). Attentional resources (Koppel et al., 2009). |
| Feedback may be communicated via an auditory interface. | Verbal communication is the most common technique used to provide feedback by DIs (Bartl et al., 2005; Hultgren, 2005; Miller &amp; Stacey, 2009). Used in Weevers et al. (2003). |
| Feedback may be communicated via a visual interface. | Drawings, pictures, movies, demonstrations and models can all serve to provide feedback (Bartl et al., 2005). Used in López-Garate et al. (2008). |
| Feedback messages needs to use simple terminology. | Guideline in Miller and Stacey (2009). Avoid using complex jargon, so that the driver understands the principles that are being communicated. |</p>
<table>
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<tr>
<th>Requirement</th>
<th>Description</th>
<th>Guideline</th>
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<tbody>
<tr>
<td>Feedback needs to be communicated in a positive or neutral manner.</td>
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<td>Guideline in Miller and Stacey (2009) and Weevers et al. (2003).</td>
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<td><strong>Trust</strong></td>
<td>The ADAS needs to be patient.</td>
<td>A DI needs to be willing to provide help, even when something has been explained several times before. By showing tolerance, pupils’ confidence will build up as well as their trust for the DI (Miller &amp; Stacey, 2009).</td>
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<td></td>
<td>The ADAS needs to be confident that an erroneous deviation has occurred before communicating corrective feedback.</td>
<td>If the system does provide legitimate feedback, it can compromise the trust in the system. If a user does not trust a given system, he or she might cease using it (Parasurman &amp; Riley, 1997).</td>
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<tr>
<td><strong>Acceptance</strong></td>
<td>The ADAS needs to be easy to use, inexpensive and robust.</td>
<td>Elderly drivers have shown attitudes of resistance against new technology because of it needed to be learned to be useful. There have also been assumptions of technology being expensive and fragile (Stave et al., 2014).</td>
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<td></td>
<td>Communicating feedback about erroneous behavior might need to contain information about traffic theory.</td>
<td>New traffic rules, new road signs, and an overall faster and denser traffic might be factors affecting safe mobility (Stave et al., 2014).</td>
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<td></td>
<td>The ADAS needs to know the driver.</td>
<td>For reaching an effective level of communication, the DI needs to have an accurate assessment of the individual’s driving ability (Miller &amp; Stacey, 2009).</td>
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<tr>
<td></td>
<td>The ADAS should not treat the experienced driver as a learner but as an equal.</td>
<td>Guideline in Miller and Stacey (2009). The DI role needs to be adjusted to an attenuated, less governing one when teaching experienced drivers.</td>
</tr>
<tr>
<td></td>
<td>The ADAS should avoid nitpicking on minor driving techniques.</td>
<td>Guideline in Miller and Stacey (2009). Training experienced drivers should focus on areas such as planning, hazard awareness, and anticipation.</td>
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<tr>
<td></td>
<td>Feedback messages might need to be more elaborated when communicated to experienced drivers.</td>
<td>Guideline in Miller and Stacey (2009).</td>
</tr>
<tr>
<td></td>
<td>Feedback communication should be welcomed - not forced upon.</td>
<td>Guideline in Hultgren (2005).</td>
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</table>

All the assessed requirements were derived from other domains - preexisting knowledge was put into a new context. To gain insights into how the requirements might change in relation to the specific ADAS idea, focus groups were carried out next.
Focus group
In addition to the literature review, a focus group methodology was carried out to gather requirements in relation to the specific ADAS idea. This kind of qualitative approach was seen as particularly useful, as it is recommended to use when an area is relatively unexplored and aims at enfolding attitudes and requirements (Morgan, 1996). Focus group interviews supports interaction amongst participants and can enrich data in a way individual interviews cannot do (Kitzinger, 1994).

Method
Participants
For the first focus group session, the ambition was to gather requirements from people that were experts in driving tutoring and whom had experience of age-related changes in relation to driving. Assumingly, that mixture could have resulted in expert influenced requirements with elderly drivers in mind. As with the literature review, it was sought after to inform the design regarding what and when feedback should be communicated. It was also seen as important to gain insights in how they thought elders preferred to receive feedback, having age-related changes in mind. Elderly DIs matched the criteria; they had expertise in DI tutoring and assumingly also experience of how age-related changes affected driving ability. Elderly DIs were therefor recruited through a vehicle interest organization called Motormännen, at their local office in the county of Östergötland, Sweden. The requirements for being able to participate in the group interview were that one needed to be: an active or former driver instructor, 65 years or older, own a valid drivers’ license and still be an active driver fulfilling the visual acuity requirement of 0.5.

Four males participated in the focus group interview with domain-experts. The first participant was 67 years old, drove circa 10000 kilometers per year, and was a part time active DI with 44 years of experience. The second participant was 77 years old, drove circa 15000 kilometers per year, and was a former DI with 41 years of experience. The third participant was 70 years old, drove circa 7500 kilometers per year, and was a former DI with 47 years of experience. The fourth participant was 75 years old, drove circa 10000 kilometers per year and was a former DI with 44 years of experience. Two more participants that fitted the requirements were invited but finally declined their participation days before the interview. All in all, each participant had over 40 years of experience of the DI profession and all four were still active drivers.

For the second focus group session, the aim was to get possible end-users’ point of view of the ADAS. They were as with the first group asked what, when and how feedback should be given. However, it was thought that this group could provide more insights regarding acceptance and trust in relation to the design, being car drivers and consumers without specific knowledge about the DI domain or the use of feedback. Elderly people were therefor recruited through a motor organization called FMK, also situated in Östergötland, Sweden. The requirements for being able to participate in the group interview were the same as for the DI group, except the DI requirement.

Five males participated in the second focus group interview with elderly drivers. The first participant was 76 years old and drove circa 10000 kilometers per year. The second participant was 74 years old and drove circa 15000 kilometers per year. The third participants was 70 years old and drove circa 12000 kilometers per year. The fourth participants was 70 years old and drove circa 20000 kilometers per year. The fifth participant was 76 years old and drove circa 15000 kilometers per year.

Pre-defined themes
The first theme was called “Challenges for elderly drivers” and aimed at introducing the participants to the discussion by asking how they looked at the challenges with car driving at an older age. The
intention was to warm up the discussion and to understand how possible declines affected the interviewees’ ability to drive.

All subsequent themes were oriented towards the design of the ADAS. The theme “What to communicate” was for discussing what the feedback needed to consist of. Guidelines had already been pointed out by the literature review, but not in the context of a feedback system integrated in the car. Arguably, feedback guidelines had to be adjusted since the messages would be communicated by technology instead of a human DI sitting in the passenger seat carrying out a normal driving lesson. The theme “When to communicate” concerned the timing of the feedback communication. Earlier literature revealed several guidelines concerning that topic, but again, not in the context of an ADAS. The closely related theme “Intrusiveness of the system” was for discussing the personality of the ADAS. The theme was derived from the domain of intelligent tutoring systems, where it was said that the system’s characteristics was highly dependent on the level of intrusiveness, i.e. the amount of feedback messages communicated. It was seen as a relevant theme since it was not known what level of intrusiveness elderly drivers preferred. The theme “How to communicate” wanted to investigate what kind of physical implementation of the system that was preferred. It was derived from the part of the literature review treating age-related declines and its effects on the driver.

The last theme was called “Acceptance and trust”. The rationale behind the theme was that good system performance may be sufficient for the technician, but it is of equal importance that the equipment is appealing for and accepted by the driver (Van Der Laan, Heino & De Waard, 1997). It was therefore of interest to study if the participants perceive the ADAS idea as something that would come in handy, and whether they thought it could help drivers enhance driving ability. The theme was also for discussing how they would feel about the system in case it failed, e.g. provided them with incorrect feedback. People have shown a tendency to trust and use systems that works without a problem (Sarter, Woods & Billings, 1997), but also a tendency to cease using it if a feeling of mistrust gains ground (Parasurman & Riley, 1997).

Procedure

The focus group interviews ran for 2 hours, including a 10 minute break for coffee and cake. The sessions were recorded with a camera and a microphone. The author of this thesis acted as a moderator by giving a brief presentation, introducing themes and facilitating the discussion amongst the participants. The moderator was responsible for maintaining the focus on the issues of interest, while at the same time minding the free-flow nature of a discussion, as recommended by Nielsen (1994). According to the plan, the procedure for both focus group interviews was the following:

- The participants were welcomed to the building of VTI in Linköping, Sweden.
- They were asked to take a seat around a table in a conference room where a consent form (Appendix A) waited for each one of them.
- The moderator started the focus group session by giving a brief presentation (Appendix B) that followed an interview guide (Appendix C). The presentation started off by showing the relationship between elderly drivers and accidents. Next, clips of poor driving performance⁵ were played to exemplify difficult driving scenarios for elderly drivers. The presentation ended by showing results from Poschadel (in press) regarding the positive effects of using DI feedback as a measure to improve driving performance. The whole presentation took approximately 15 minutes.

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⁵ Data from Broberg and Willstrand’s (2014) study was used during the presentation. Four videos of different elders driving in different intersections were selected and presented based on their low score in that study’s DI assessment.
• After the presentation, the themes were discussed.
• To support the discussion, a prepared use case (Appendix D) was demonstrated when approximately 30 minutes had passed. The rationale behind this decision was that use cases can encourage the creation of requirements in relation to a given system (Maguire, 2001; Benyon, 2010).
• After the session, the DIs were thanked for participating by receiving some giveaways provided by VTI.

Analysis
The analysis of the collected data was conducted in line with the recommendations for thematic analysis suggested by Braun and Clarke (2006). The video and audio recordings were watched and re-watched. At the same time, the verbal conversations were transcribed into a chronological order of text (Appendix E). After this familiarization process, text segments that shared a common pattern were coded and sorted under themes. The themes were either pre-defined or emerged through the coding process. The latter refers to themes that were created through an inductive analysis, meaning that data was sorted without trying to fit it into any of the pre-defined themes. The majority of the collected data was however coded and sorted under the pre-defined themes, a procedure called deductive analysis.

A requirements assessment was then performed on the data that the pre-defined themes contained. The requirements analysis aimed at gathering requirements that the participants not only explicitly posed on the system e.g., “I want the system to be able to do this”, but also implicit requirements, informed by the participants experience and knowledge in other domains e.g., “in my profession, we usually do this”. The justification behind this was that users might have an incomplete understanding of the problem domain and consequently may not know what they explicitly need in relation to a given system (Christel & Kang, 1992). As with the literature review, the requirements were sorted depending on their relevance for the different aspects of the ADAS (see Table 1).
Results

Elderly driver instructors

Regarding the theme “Challenges for elderly drivers”, the participants told several anecdotes on how age had affected their own and relatives’ driving. Eye-sight was a common decline they all shared, something that had weakened as they got older. One participant described the unpleasant combination of driving at night when it was raining, and on top of that having to wear glasses and look through a water soaked windshield - as if a declining vision was not bad enough. Two participants referred to their wives describing how they did not want to drive in the dark any longer. “In fact”, one said, “I think those ladies that have reached older ages drive very little. It only happens when their husband eventually get sick and cannot drive anymore”.

There was a story where the husband got very ill and the wife had forced herself to start driving after all the years in the passenger seat. The couple did not want to end up in a situation where they could not go anywhere. The immobility would have affected their whole living situation; everything from being able to visit their grandchildren to having to sell their summer house. The DI thought that it was probably a common scenario, trying to maintain a standard of living by driving even if one did not want or had enough practice to do it in a safe manner. “Elders in general drive too little. Maybe just every other weekend, or to the summer house, or the shopping center, but not very often”.

One story had to do with an older lady that only drove a specific route from her apartment in Linköping to her summerhouse at the lake – never to any other place. “There is a big difference between driving in familiar places compared to driving where one is not used to drive, and this difference gets bigger as you get older”. Driving context seemed to play an important role for the DI. “You need to be on your toes when driving in new environments”. He described that principles of driving in traffic were indeed the same from place to place, but driving on unfamiliar roads was nonetheless troublesome. Another DI chipped in “I’ve met a total of three elders driving in the wrong direction in roundabouts”. He said that this had happened when he was still an active DI, and the story behind was the same for all cases: “They thought it was a normal intersection and consequently took a left turn”.

The DIIs all agreed that there did not seem to be any convenient way of getting updates regarding new or revised traffic rules. “There is a preconception, that if one have a drivers’ license, you supposedly know about traffic rules and keep yourself updated about them. But people that took their license 40 years ago generally don’t look for this kind of information”, said one of the DIIs and then another one said “It’s something that we also notice when we educate parents to driver students. They usually come and thank us after the course for refreshing their knowledge”. The DIIs had several stories about middle-aged and elderly drivers that drove poorly in relation to traffic laws, either because the rules were forgotten or had entered into force after they took their license.

Talking about the challenges with driving at an older age, there was a consensus about the necessity to adapt to ongoing changes in the body and head. As one of them said “If I want to do something, it might take double the time compared to when I was younger. You need to adapt”. One related reflection was that “Some might not be aware of their bad driving. If they drive by themselves, they might not receive any feedback from anyone”.

A while into the discussion, the idea of a system for feedback was introduced by the moderator, and the theme “What to communicate” was tentatively discussed. One DI emphasized that giving feedback to an elderly experienced driver was not the same as when teaching inexperienced pupils. “One needs to be more careful in such cases”. The conversation was a bit stumbling as predicted, and therefore an early use case scenario was demonstrated to get the discussion going. As with the other themes concerning the idea of an ADAS for feedback, the DIIs tended to refer to anecdotes when discussing
the system – something they had experience of and could relate to. “After an incident in an intersection, I usually ask [the pupils] whether they think that they acted right or wrong. In case they don’t have a clue of what went wrong, I tell them to turn back to do it all over again”, said one DI.

While discussing “When to communicate”, one of the DIs remembered a trip to Singapore where he at one point was sitting in a taxi cab. The chauffeur was repetitively getting warnings from some system when he drove above the speed-limit. The DI did however not think that it was the best way of trying to correct peoples’ driving. “When I’m seated as a passenger with a friend, it’s up to them to ask me for feedback on their driving. In that case it feels right to tell them, I would never do it otherwise.”

Another DI disagreed saying that corrective feedback should come “instantly”. Talking about the closely related theme “Intrusiveness of the system”, one DI pressed on the importance of giving them some time to breath between new things to be learned: “In a driving lesson, there are various exercises that are planned to be conducted. Consequently, one type of exercise cannot take up the whole lesson. Not the least because it will make the students feel incapable if you repeat the same thing over and over again”. In line with that reasoning, another DI said that he did not always instruct or interfere during a driving session. Sometimes the mistakes were only noted, as long as the mistakes did not have any possible accident as a consequence.

Regarding the topic of “How to communicate”, the four agreed on that most effective way to correct erroneous driving was to revisit the “crime scene”. “Unfortunately”, as one of them said, “it’s probably not the same traffic situation as when the incident happened”. Drawings, pictures, videos and other tools were also mentioned as a way of communicating feedback. One DI had a picture taken from a helicopter over a roundabout that he used to illustrate how the traffic flow worked. “That picture was great to make pupils understand how a roundabout works. It was something that we couldn’t teach easily while sitting in the car”. Another DI reflected over the use of tools and said that it would have been desirable with moving pictures to catch the dynamics in different traffic situations. The DI who had just mentioned the picture taken from a helicopter then started to tell a story of when they more or less out of coincidence used a video camera.

“A period of time we filmed the driving sessions with motorcyclist students. Because when weather was bad, we sat in a car and drove behind [instead of also driving a motorcycle]. During those sessions, we took the opportunity to record the driving from the car. It was perfect, the student drove a while and then we stopped and gave them feedback. /…/ It worked out very well and they really took notice when they had their own driving behavior on videotape”.

Reflecting over the use case scenario that was demonstrated, all four DIs explicitly mentioned their preference for verbal feedback. A part of the discussion went like this:

**Participant 4:** “I don’t believe in solely using pictures for communicating feedback”.

**Participant 3:** “All in here have showed video for our students. It might help to some extent, but later while driving, the information seems gone”.

**Participant 2:** “It certainly doesn’t have an effect on its own, but in combination with driving sessions, it works”.

Parts of the discussion regarded the “Acceptance and trust” of the system. One DI thought that the more technology that was introduced in the car, the less one needed to think of his or her own driving. In an exchange of opinions, one of them said that “I don’t know if I would be able to trust such a system”. Another one then replied “let’s not be old-fashioned - we invented the car once. I think it
would be helpful with feedback that gave a little afterthought.” However his opinion was not without reservations since he thought that the feedback needed to be informed by someone with a great deal of knowledge, such as himself. And he was not fond of the idea of having assistant systems meant for elderly drivers specifically. “You can’t just tell old people that they’re now 65 years old and because of that are in need of such a system”. Another DI agreed and said that feedback is good independent of age. However, they were not too sure how they would react in a situation where they themselves were told what to do better. “We all need feedback, no one drives perfectly. But as a former DI, I don’t think I would receive it too well”, one DI assumed. “I don’t know how I would react to such a thing”, another one said.

One of them thought that the drivers who would have no problems receiving feedback were the ones that drove seldom and already knew about their bad driving. “It’s another matter”, he said, “when considering those that drive poor and on a regular basis. Their driving is saved by the adaption of the surrounding traffic. But maybe, given that they are made aware of their errors, some afterthought might slink by that leads to an insight of what needs to be corrected”.

In addition to the pre-defined themes, two others emerged in the course of the analysis. The elderly DIs all lobbied for the installation of retraining programs in Sweden – thus the theme “Retraining programs”. Both theoretical and practical driving sessions were seen as options. There was a consensus regarding the lack of a control function for testing people’s ability to drive safely. “When having a flight certificate”, one said, “you must fly a certain amount of hours per year to maintain it valid. On top of that, you need specific certificates for different types of situations, one for night flying for example.” Another DI agreed saying that too little demands were put on drivers. “It needs to come from the state, otherwise people won’t do it. For example, it could be realized in terms of a program where people received lessons for free after a certain age. But it needs to be mandatory; if it’s not, people won’t show up and the ones that do don’t need it”.

The final theme that emerged was the one called “Feedback is not enough”. This theme did not have anything to do with the use of feedback, instead it covered other techniques used by DIs to maintain safe driving. Feedback communication was not seen as a single solution for safe driving as one DI implied saying “There should be a system that stops bad driving behavior that is carried out consciously. I had a student that drove like a car thief. I told him to shape up because neither I nor the other DIs at the driving school wanted to sit in the passenger seat next to him.” He then continued telling that the same student later received his driver’s license and tragically killed both himself and his wife on a slippery road. “For some, talk and pictures is not enough”, one of the DIs added.

They then started to discuss other possible solutions besides giving feedback. “If the car was aware, it could instruct the driver by informing him when getting closer to a given traffic situation /…/ It’s what we do, we see risky traffic situations before they happen”. Interfering to avoid accidents was also seen as an option. “Of what use is feedback if an accident happens because the driver was not told to look both ways in an intersection? If a student doesn’t look where he is supposed to look and we see a possible accident scenario developing, we interfere.” When the moderator said that the proposed feedback system was about trying to avoid ending up in such hazardous situations, one DI replied: “As in other parts of our lives, we need to experience failures to wake up. /…/ At the same time, and I guess that’s what we are here to discuss, one shouldn’t have to experience a near accident to understand that something needs changing. This is where the feedback system can serve a purpose”.
Elderly drivers

Concerning “Challenges for elderly drivers”, it was apparent that some of the elderly drivers’ experiences overlapped with those of the DIs. “Big changes takes place when one gets old. I notice it myself when I’m out driving in the dark. My night vision is not what it used to be”, said one of the elderly drivers. Others agreed uttering that driving in the dark was even worse in combination with rain. Adaptation of driving with regard to bodily changes was seen as a necessity but not always easy to act in accordance with:

“Keeping up with the traffic flow is more taxing today than it was before. You might want to drive at a lower speed when you’re older, but then you get baited by someone who, for example, really wants to be driving at 90 on a 90-way, when you yourself might want to be driving at 80. Society is pushing us to drive in a pace that we are not comfortable with”.

Another elderly driver agreed saying that he, at this day and age, tended to get irritated by other drivers whom he perceived drove aggressively or over the speed-limits. He recalled the good old days when drivers showed consideration for those that were from out of town. This was possible due to the license plates being coded after the region that one came from. By looking at a car’s license plate, one could easily tell if the driver was from the city or from the outskirts. Someone from out of town would generally drive more slowly in the city and the reason could be interpreted just by looking at the plate. He thought it was a pity that the system – in Sweden – was long gone.

Traffic signs were a discussed topic. Referring to one of the videos that were shown in the introduction, one participant stated that driving in towns was difficult, partly because of the many road signs and their localization in the road infrastructure. The video had illustrated the difficulties and confusion an elderly man went through when trying to navigate through a city with traffic signs positioned over the roads, making them hard to read from the driver’s point of view. The elderly driver said that he felt for the man, because he too thought it was hard to read signs in the sky while at the same time maintaining the right position on the road, especially in unfamiliar traffic situations – “sometimes you can’t keep up”. Apart from sign positioning, there seemed to be a general dissatisfaction concerning those that had been recently introduced, such as big red information signs at construction sites that were seen as distracting. Moreover, newly introduced speed limit signs had steered up confusion on what used to be familiar roads for some of the participants. “I can’t easily tell what the speed limit is any longer ... 30, 40, 60, 80 km/h – nowadays every possible sign seem to exist”. As with the DIs, the elderly drivers too agreed that there didn’t seem to be any convenient way of getting updates regarding traffic rules and other changes in the infrastructure. One of them acknowledged that he was not sure about newly introduced traffic rules. Another elderly driver thought that there maybe was a mobile app with the latest traffic theory, but he was not sure.

The discussion regarding a feedback system was of a different kind than the one with the DIs. Assumingly this was the case since this group did not look at the proposal as domain-experts, but rather as normal car drivers and consumers. Nevertheless, they too drew from experience when discussing the matter of “What to communicate”. The similarities between their wives and the proposed system soon led to a lighthearted atmosphere. After all, both supported the driver by giving corrective feedback. “My wife usually gives me feedback regarding speed adjustment”, one said and others agreed. One common remark was that “It’s XX km/h here and you are driving at XX km/h”. Another elderly driver said that his wife used to keep a look-out on roads where there was speed cameras. Another common context where their spouses gave feedback were parking situations; they assisted their husbands by providing information about the distance to objects near the car. When the
moderator asked how they reacted on comments from their wives, one elderly driver said “Well, you better conform because if not, you are going to have a discussion”.

There was a change of mind by one of the participants while discussing “When to communicate” and “Intrusiveness of the system”. Primarily and before the use case was presented, the elderly driver stated that the feedback should be given at once after a given incident. This account, by the way, made another participant remember his in-built GPS system that constantly nagged about where he should drive. After the use case was presented, the moderator challenged the earlier statement by questioning if instantaneous feedback was a good idea considering that others might sit in the car, thus potentially leading to a socially awkward situation, and that it also might interfere with the current driving task. The same participant then said: “It’s worth a lot of consideration. Because if someone drives erroneously all the time and consequently gets that information showed up in the face, it might not lead to better driving.” He continued his reasoning by expressing that it might be for the best if it was up to the driver when to receive the feedback, but at the same time he acknowledged the risk that a driver might never feel like doing such a thing.

“How to communicate” was only briefly discussed. An elderly driver mentioned that a “pling plong” sound could be played when the system “had something on its mind”. He expressed that such a cue could be a way for drawing attention to the feedback system. When the moderator asked how it would be if their spouses waited with giving (auditory) feedback till when the destination had been reached, one participant said “Well, by then you would’ve forgotten about the incident and not be able to associate what the feedback was about”.

There was a diversity of discussions in relation to “Acceptance and trust”. In general, the elderly drivers seemed to share a positive attitude to assistance systems. One of them expressed that a system he had in his new car, which registered speed-limit signs, removed the effort of trying to remember the right speed on a given road. Another participant was fond of a system that warned him for approaching speed cameras. Speaking about a feedback system, there were some uncertainties. One participant was worried that it could compromise drivers’ integrity, given that it could track and save driving related information. Another elderly driver was not sure how drivers would react to feedback, “one might for example get irritated”. When the moderator asked how they would react if the system gave them feedback that was obviously wrong, two answers were: “Well, it’s going to be a bad atmosphere in the car”, and “It’s only trivialities, I would just carry on with whatever I was doing.” While discussing willingness to own such a system, a part of the discussion went like this:

Participant 3: “I’m not sure that I would buy it as an add-on, how would that work out? I have an older car.”
Participant 1: “I think it’s more likely that new cars are equipped with it, and that begs the question of how much it will cost.”
Participant 5: “Well, I wouldn’t buy a new car just to get feedback on my driving.”

Another participant continued the discussion saying that it would be great if such a system was included as standard equipment, and the others agreed. One participant concluded his view of a feedback system saying “I think it’s good; you get education and reminders at the same time. But it all comes down to how much it will cost. /.../ It might become hard to absorb the feedback since it won’t directly prevent accidents, so to speak. It is a matter of designing it in a way so it gets used.” Another participant chipped in “I think the idea is good. One tends to cradle into a rhythm and behavior without reflecting, and it might be filled with errors.” As with the DIs, one elderly driver pointed out that the system should not discriminate certain drivers. “We don’t always drive well, and technology can help us for sure. But one can’t just dedicate this system especially for elderly drivers.”
Following the same pattern as the discussion with the DIs, the theme “Retraining programs” emerged through the session. One elderly driver seemed especially keen in the matter, and wondered why there was no kind of retraining or health checks when drivers renewed their licenses every 10th year. He saw this as a window of opportunity to refresh drivers’ theoretical knowledge about traffic rules and also as a point where brief medical examinations could be done. In addition to this proposal, he thought that the intervals between the license renewals needed to shrink from 10 to 5 years, after the age of 65. Others agreed and he summed up by saying:

“I think this feedback system would be to good use in what I’m suggesting. I think that before one receives a renewed license, there should be some kind of theoretical education, a health check and then some kind of evaluation using a system such as this. /.../ There are no astronomical costs here, and society would get a lower amount of accidents in return.”

Assessed requirements

Table 3 contains the assessed requirements from the focus group interviews and has three columns. The left column describes what aspect of the ADAS idea that the requirement is about. The middle column contains the requirements, developed through the analysis made on the predefined themes. The right column shows what statements the requirements stems from.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Requirement</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>What to communicate</td>
<td>Feedback needs to start by questioning whether the driver is driving properly before giving feedback.</td>
<td>Stated by a DI: “After an incident in an intersection, I usually ask [the pupils] whether they think that they acted right or wrong. In case they don’t have a clue of went wrong, I tell them to turn back to do it all over again”.</td>
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<td></td>
<td>Feedback needs to communicate what the driver is currently doing wrong.</td>
<td>One common remark by the elderly drivers’ spouses was that “It’s XX km/h here and you are driving at XX km/h”.</td>
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<tr>
<td>When to communicate</td>
<td>Feedback needs to be communicated optionally.</td>
<td>Stated by a DI: &quot;When I’m seated as a passenger with a friend, it’s up to them to ask me for feedback on their driving. In that case it feels right to tell them, I would never do it otherwise”. One elderly driver stated that it might be for the best if it was up to the driver to choose the time for receiving feedback.</td>
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<td></td>
<td>Feedback communication needs to be of low intrusiveness.</td>
<td>Stated by a DI: “The student will feel incapable if you repeat the same thing over and over again”. One elderly driver stated that frequently being exposed to feedback while driving might be negative in relation to performance.</td>
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<td></td>
<td>Verbal feedback needs to be communicated in close proximity to an incident.</td>
<td>It was stated by a DI and an elderly driver that feedback should be communicated directly after every incident.</td>
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<td><strong>How to communicate</strong></td>
<td>The ADAS interface needs to take visual declines into account.</td>
<td>The majority of the DIs stated that visual declines were common amongst them and their relatives. Eye-sight declines was also reported common amongst the elderly drivers.</td>
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| Feedback may be communicated via an auditory interface. | The ADAS needs to represent occurred incidents. | The majority of the DIs agreed on that most effective way to correct erroneous driving was to revisit the “crime scene”. One DI stated: “[The students] really took notice when they had their own driving behavior on videotape”.

<table>
<thead>
<tr>
<th>Feedback may be communicated via a visual interface.</th>
<th>The ADAS interface may notify the driver with cues regarding feedback messages.</th>
<th>An elderly driver stated that a “pling plong” sound could be played when the system had something on its mind.</th>
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<tbody>
<tr>
<td>Trust</td>
<td>No feedback is better than wrong feedback.</td>
<td>It was stated by an elderly driver that there would be a bad atmosphere in the car given that the system provided wrong feedback.</td>
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<td>Acceptance</td>
<td>Communicating feedback about erroneous behavior might need to contain information about traffic theory.</td>
<td>Some DIs and elderly drivers stated that there was no convenient way of getting updates regarding new or revised traffic rules.</td>
</tr>
<tr>
<td>The ADAS should not target elderly consumers specifically.</td>
<td>Stated by a DI: “You can’t just tell old people that they’re now 65 years old and because of that are in need of such a system”. Stated by an elderly driver: “We don’t always drive well, and technology can help us for sure. But one can’t just dedicate this system especially for elderly drivers.”</td>
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<tr>
<td>The ADAS should not compromise the driver’s integrity.</td>
<td>There were worries amongst the elderly drivers that the system would compromise drivers’ integrity, given that it could track and save driving related information.</td>
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<tr>
<td>The ADAS needs to be inexpensive and preferably a part of the standard equipment.</td>
<td>Some elderly drivers stated that cost was important and that the ADAS preferably should be included in the standard equipment.</td>
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Discussion

The overall objective of this thesis was to explore the idea of an ADAS that gives feedback on driving. More specifically, it was sought after to inform the design of the ADAS by assessing requirements regarding what, when and how feedback should be communicated to elderly drivers. Additional aims were to assess requirements that could affect the acceptance and trust in relation to the ADAS. The assessed requirements gives a hint of what the design of such a system might need to adhere to if it is to be implemented and used as intended.

Requirements and implications

“What to communicate”. Surprisingly, none of the DIs gave examples of verbal feedback that was in line with the guidelines addressed in the literature review. Miller et al. (2009) suggests that feedback should consist of what went wrong and a comment that indicates what actions must be taken to correct it. This suggests that feedback needs to be about a faulty action and not the person that committed it (Hultgren, 2005). Contrary to these recommendations, one DI reported that he used to question whether students thought they acted right or wrong after an incident. The elderly drivers’ spouses, probably more understandably, also seemed to remark on the person instead of the committed error. An interpretation of these results is that both the DIs and the spouses provided feedback improperly. Anyway, the discrepancy between these findings and the literature review suggest that feedback messages will have to be carefully constructed. They need to be adjusted to experienced drivers that have been driving for many years and that might not be accustomed to corrective feedback from other parties, let alone from technology.

“When to communicate”. One could easily dismiss the focus group requirements regarding the system’s temporal aspects as contradictory. After all, contradictions have been pointed out as a main problem when assessing requirements from stakeholders (Christel et al., 1992). Some wanted the feedback to come automatically and in close proximity to every incident. Others wanted it to be of a more passive nature, only possible to receive when the driver wanted to. Some changed their mind.

Strictly speaking, there were two main camps, namely: “Feedback should be communicated directly after an incident and have high intrusiveness”, and “Feedback should be communicated when the driver wants it and have low intrusiveness”. It is suggested here, that these requirements should be looked upon as two extremes of a spectrum rather than contradictory to one another.

To further complicate matters, the abovementioned aspect is highly related to “How to communicate”. Because the medium used to implement the feedback system makes different times for communication more or less feasible. Let us elaborate: If the system is solely auditory based, then the feedback needs to come in close temporal proximity to the incident to make the association possible – this is how DIs work when they are out driving with students (Hultgren, 2005; Miller et al., 2009). The advantages, in relation to a graphical user interface (GUI), is that the driver can keep his eyes on the road while at the same time listen and correct the ongoing driving task. So if the driver’s goal is to effectively improve driving performance, and does not mind an always correcting ADAS, than this is arguably a good choice of medium, timing and intrusiveness. Naturally, some DIs clearly expressed their preferences for this type of auditory interface with high intrusiveness. However, there are some disadvantages. It might for instance lead to socially awkward situations in the car, because others might hear about the driver’s mistakes. It might also paradoxically compromise driving performance by disturbing the ongoing driving task, as noted in Weevers et al. (2003). Furthermore and as one DI reported, it can also lead the driver to feel incapable if corrective feedback is frequently repeated.

The DIs agreed on that the best way to correct erroneous driving is by revisiting “the crime scene”. But as they expressed, this is seldom possible in the real world since traffic scenes changes; it is hard to
catch the same dynamics two times in a row. However, one DI remembered himself using video recordings as a way of pointing out where drivers had performed poorly. By visually representing the situation where an error had occurred, i.e. by revisiting the “the crime scene”, video recordings allegedly served as an effective tool when giving feedback to the driver. Why might this be? Driving is primarily a spatial task and visual illustrations, representing spatial relationships of an incident, might be more suitable than only verbal feedback for detecting and correcting spatial behavior. Visual feedback is also less temporarily dependent than verbal feedback since the latter needs to come in close proximity to an incident to make an association possible. A visual medium is not without disadvantages though. If active interaction with a GUI is required to take part of feedback, one needs to keep in mind that elderly drivers have reported attitudes of resistance against new technology, since it needs to be learned to be useful (Stave et al., 2014). Moreover, it might be inappropriate to interact with a GUI while driving because attention and vision would need to be reallocated from the driving task to the screen. Consequently, a GUI makes less intrusive communication more suitable, because the safest time to attend to a screen in a car is arguably when a person is not driving, e.g. before or after a given driving session.

An older person’s primary goal when driving is probably not to improve driving performance per se, but to fulfill other goals in life such as visiting relatives or the shopping mall. If a system unwelcomely interferes in these goal pursuits, it might lead to irritation and a lack of acceptance. As was stated by some of the elderly drivers, a system with optional feedback, i.e. a less intrusive communication, would be easier to accept as a normal driver. This is in line with Van der Laan et al. (1997) who notes that systems that restrict the driver’s behavior or policing systems that force a behavioral change, are likely to be less accepted than non-restricting systems. The balance between trying to change an elderly driver’s behavior and his acceptance towards the ADAS may be a hard one to pull off. One possible solution to this matter is an interface that starts by notifying the driver with subtle cues, given that the ADAS has something on its mind. This could be a way for the ADAS to not get in the way of goal pursuits, but at the same time make the driver attentive on occurred driving related errors. The solution could work much the same as an ordinary email application: When an error occurs (when an email gets received), the ADAS (or the email application) notifies the driver - rather than forcing the driver to attend to it (or the user to read the email). Feedback should be welcomed - not forced (Hultgren, 2005).

Summing up the discussion regarding when and how to communicate feedback, the recommendation here is that these aspects ought to depend on the goals with the ADAS. Is the ADAS meant to effectively improve driving performance? Choose an auditory interface with high intrusiveness. It the ADAS meant to be used by normal elderly drivers without it interfering with their daily lives? Choose a visually based interface with low intrusiveness. With that said, using more than one medium and intrusiveness level might carry more advantages than sticking with one. Feedback concerning large deviations from safe driving might be sound to communicate verbally during the driving session, in close temporal proximity to the unwanted behavior, as the literature review suggests (Hultgren, 2005; Miller & Stacey, 2009). Feedback concerning less critical errors, or errors that needs elaborated visual feedback to be understandable, might be more adequate to communicate while not driving, through a GUI. In any case, feedback should be communicated with either a neutral or positive tone (Miller & Stacey, 2009).

On an additional note on how to communicate, participants in both focus groups told stories about their own bodily declines and the effects it had on driving. Prominently, visual declines seemed to have a large impact on driving. This is in line with earlier research and implies that if the ADAS’s interface is to be visually based, it will need to take declines in peripheral vision, contrast sensitivity, glare sensitivity and visual acuity into account. And although not explicitly reported by the participants, losses in hearing, stiff physics and cognitive declines are present in the elderly community in varying
degrees according to the literature review. These declines poses design constraints independent of the interface being visually and/or auditory based, because feedback communication will not lead to self-assessment nor self-regulation if it cannot be easily heard, seen or attended to.

Besides auditory or visually based interfaces, no other types were treated in the literature review nor the focus group interviews. A signal based interface to communicate feedback, such as vibration, light or sound signals, might for example carry advantages that have not been highlighted in this thesis.

“Acceptance and trust.” The level of acceptance will probably be related to the design of the ADAS – the what, when and how feedback is communicated. It will most probably also be related to the trust in the system. If wrong feedback is given, e.g. the system thinks the driver has done something erroneous when that in fact is not the case, this could lead to mistrust and disuse. As one elderly driver said, “it would lead to a bad atmosphere”. A system that basis feedback on deviations that might be rightly made by the driver runs the risk of providing wrong feedback. Tendencies of this problem were noted when evaluating the intelligent tutoring system reported in Weevers et al. (2003). To be on the safe side of things, it might therefore be sensible to call for some degree of conservatism; provide feedback only when a clear pattern of erroneous behavior has been established or when the deviations from safe driving are certain. In time, progress in technology might open the path for enhanced ways of monitoring traffic environment and the driver, leading to better and more detailed informed feedback. Eye-tracking might be one such example of technology, with the ability to track the driver’s visual behavior. If technology makes it possible to monitor and save a model of the driver and that model’s progression, tailored feedback might be a possibility.

Acceptance for the ADAS might increase by communicating information about traffic theory. The elderly drivers mentioned the apparent lack of convenient ways of acquiring updates regarding traffic rules, which has also been reported in Stave et al. (2014). A long time had passed since the elderly drivers took their license and some of them expressed their doubts regarding traffic theory. This problem might not explain elderly drivers’ over representation in intersection accidents, since those situations and applicable rules arguably have been around for a while. But a lack of knowledge may lead to doubts that at least do not make it easier to drive safely. A feedback system can be of help here by providing information regarding traffic rules, either when they are broken or when the driver wants to know.

One of the points that were made by the elderly drivers was that the willingness to own a feedback system came down to how much it would cost. As was expressed, some would prefer it to be a part of the standard equipment. Another issue was that there were worries that it could compromise drivers’ integrity, given that it could track and save driving related information. There were also concerns about discrimination as a result of dedicating the ADAS to a certain age group. Last point was in line with comments from the DI session. Understandable implications to these matters are that drivers’ integrity might need to be protected and that it probably should not be marketed exclusively to elders.

With the aspects of the ADAS discussed, one theme that emerged from the focus group with the DIs was “Feedback is not enough”. This theme highlights the elephant in the room: The difference between violations and errors, or the difference between intentional and unintentional deviations from normative performance (de Winter et al., 2007). Corrective feedback may not change everyone’s behavior, because some drivers commit deviations intentionally. Especially those who over estimate their driving ability (Broberg et al., 2014). As one DI said, “For some, talk and pictures is not enough”. With this in mind, it might therefore be a good idea to explore other concepts that draws from the DI profession. The metaphor explored in this thesis is powerful in the sense that there are more
techniques a DI uses to teach and maintain safe driving. Instructions, warnings and physical interferences being three of those.

Methodological limitations
The literature review aimed at reusing already existing knowledge in a new domain. This might be problematic since requirements from other domains may not be possible or reasonable to integrate into a new one (Christel et al., 1992). Consequently, some of the resulting requirements from the literature review might be useful for the ADAS, while others only suits the specific area that they stem from.

The majority of the assessed requirements from the literature review were based on the implicit assumption that the agent was human DI – not a technological artifact. Consequently, many guidelines were pervaded by implicit assumptions, a known problem when assessing requirements (Christel et al., 1992). A tough part of the analysis was therefor to shape the knowledge to fit the proposed ADAS. While analysis mostly led to detailed requirements, sometimes it resulted in more vague ones. It might for example be hard to inform the design in a way so that the ADAS is perceived as treating the driver as “an equal”, a requirement that stemmed from Miller and Stacey (2009). It does however not make the requirement irrelevant – but it needs to be broken down to sub requirements in order make it possible to address it in the design process.

On a final note concerning the literature review, other domains with relevance for the idea might have been overlooked. There is for example a considerable amount of research about teaching in various fields, which can be of help when designing the proposed ADAS. However, sooner or later it might be more pragmatic to look into the specific design problem, rather than examining preexisting knowledge. This was why the focus group interviews were carried out.

The choice of having few focus groups came down to the fact that this type of methodology is time consuming to prepare, execute and analyze, making it difficult to conduct enough sessions to be able to generalize any results. It was arguably better, as Morgan (1997) recommends, to strive for a more theoretically motivated sampling, given the time and resource constraints of this thesis. Choosing elderly drivers from a motor organization was because randomly sampled participants can run the risk of not being able to generate a meaningful discussion about the topic that is of interest. This is why it is recommended that the group composition ensure that the participants have something to say about the topic and feel comfortable saying it to each other. Homogeneity between the participants generally allows for more free-flowing conversation than in heterogenic groups (Morgan, 1997). It would however be of interest to understand other possible end-users attitudes and requirements, such as elderly women without much experience of driving. Efforts were made to establish such a focus group through the National Pensioners’ Organization, but to no avail.

While the elderly drivers were strangers to each other, the elderly DIs were acquaintances. This was known during the recruitment process but was not seen as an issue since the topic of interest was a system, rather than something that would be sensitive to opinionize about amongst acquaintances. As the results of the study shows, participants in both groups were sufficiently comfortable with each other to exchange different opinions, providing different perspectives and requirements on the proposed system.

Both sessions were standardized in the sense that they followed the same procedure and level of moderator involvement. Structured approaches are seen as useful when there is a preexisting agenda (Morgan, 1997). This was arguably the case in this thesis, with a narrow set of themes that the moderator tried to focus on. The many overlaps in the produced data between the two groups can
have different explanations. One explanation being that the presentation in the introduction as well as the use case, served to bias the discussion. Or that the participants were similar. The overlaps could also be explained by the narrow set of themes, without much space for a big amount of opinions. The rationale behind showing a use case was to inspire the creation of attitudes and requirements in relation to the proposed system (Maguire, 2001). It was thought that only discussing an abstract concept would not lead to any concrete opinions. Indeed, even after showing the use case, participants tended to express their opinions by referring to experiences rather than the system. A possible explanation to this could be that it was hard for people to discuss something that had not been tried out nor thought of before.

Another method to acquire requirements would for example have been one to one interviews (Maguire, 2001). The choice fell on a focus group methodology since detailed elaborated requirements in relation to the proposed system was not predicted to be assessed to any large extent by interviewing individuals. It was thought that it would be more effective, from a need assessment point of view, to investigate what larger amount of people had to say when discussing the topic. Another method to acquire requirements is user surveys (Nielsen, 1994). User surveys provide a tool to effectively assess the requirements of a large amount of users. After consideration, focus groups were finally seen as advantageous since it allowed the interviewer to probe a problem space without restricting possible answers. It also opened up for the necessity to explain questions in more depth and the ability to rephrase when the questions were misunderstood. Also, interviews allowed the interviewer to opportunistically ask follow-up questions that were not in the interview guide.

Both focus groups had a relatively small amount of participants. The rule of thumb is 6-10 participants per focus group, but 3 or 4 participants can be sufficient (Kitzinger 1995; Morgan 1997). Small groups run the risk of having difficulties with maintaining a discussion, given that the topic is not of interest. This was arguably never a problem in the two lively sessions that were held, with 4 and 5 participants respectively. The rule of thumb when determining the amount of groups is to stop collecting data when the moderator can anticipate what will be said in the next group – the goal of “saturation” (Morgan, 1997). Thus, if discussions in two focus groups differ, then this is a fair warning that saturation has not been achieved. This was arguably not the case when looking at the overlapping data that both groups produced. However, the saturation objective would possibly not have been met if participants of elderly drivers, without specific interest in vehicles or connections to motor organizations, had participated in the study. But as earlier mentioned, people without interest in a given topic might have a hard time discussing something that is not of real interest. The results in this study should in any case not be interpreted as representing a full spectrum of requirements for all elderly drivers, not even close. But it might help to inform future directions when designing the system.

Final remarks

Drivers are getting older in the western world and elderly people will probably try their best to stay mobile to maintain their standard of living. If the ambition of the car industry is to keep these and other people safe, systems such as this proposal might be of use in such an endeavor. Many questions are still unanswered: How should it appropriately be designed? Would it gain acceptance? Would it improve elderlies driving performance? At this stage, it is hard to conclude anything in relation to these questions. Except that what, when, and how to communicate feedback, will be important aspects to consider if one attempts to design the ADAS.
References


Hultgren, Å. (2005) *Bilförrer 65+*. Stavanger Offset AS.


Kitzinger, J. (1994). The methodology of focus groups: the importance of interaction between research participants. *Sociology of health & illness, 16*(1), 103-121.


Poschadel, S. (in press). Improved driving performance of elderly drivers (70+ years) by training in real traffic: a control group based study.


Viano, D. C., Culver, C. C., Evans, L., Frick, M., & Scott, R. (1990). Involvement of older drivers in multivehicle side-impact crashes. Accident Analysis & Prevention, 22(2), 177-188.


Appendix A

Samtycke till deltagande

Intervjun kommer att spelas in för analys och kommer senare användas som en del av ett examensarbete. Allt som framgår under intervjun kommer att avkodas, så att ingen koppling mellan dig som deltagare och det som sägs finns. Allt deltagande är frivilligt och du får när som helst avbryta ditt deltagande utan att behöva förklara varför.

Om deltagaren

Kön: ___________

Ålder: ___________

Mil per år: ___________

År som trafiklärare: ___________

Fullgod syn för körning med eller utan synkorrigering (ringa in): Ja/Nej

Namn: ______________________ Datum: ______________________
Appendix B
Appendix C

**Intervjuguide**

**Inspelning:** Den här gruppintervjun spelas in. Det kommer inte finnas någon koppling mellan er som individer och era svar i det material som senare presenteras.

**Introduktion:** Bakgrunden till varför vi sitter här är att man sett att äldres körbeteende inte är helt trafiksäkert alla gånger, vilket bekräftas av olycksstatistiken [VISA STATISTIKDIAGRAM]. Jag har tänkt spela upp ett par exempel så ni själva får se vad som kan gå snett [VISA KLIPP]. Återkoppling har visat sig kunna hjälpa äldre till att köra bättre och säkrare [VISA FEEDBACKDIAGRAM].


Så här tidigt i utvecklingsskedet är syftet att samla in tankar och behov från er med kunskap inom området. Dessa omsättas sedan i krav som formar systemet när det byggs. Alltså, om ni säger ”så här skulle systemet kunna fungera”, så blir detta något man tar i beaktande när man utvecklar systemet.

**Tema Utmaningar för äldre förare**

Vad ser ni för utmaningar med bilkörning när man blir äldre?

- Finns det behov av stöd i bilar för äldre?

Förklaring: Något som man kan relatera till och som ger en inblick i synen på bilkörning när man är äldre.

**Tema Vad ska kommuniceras**

Vad tycker ni återkoppling ska bestå av?

- Var det skedde
- Vad som gjordes fel
- Hur man bör göra
- Beroende på typ av incident
- Annat?

Förklaring: Vill föraren veta var och vad som gick snett eller räcker det exempelvis bara med allmän vägledning om hur ens körning kan göras trafiksäkrare.

**Tema När ska det kommuniceras**

När i tiden skulle ni vilja ha återkopplingen kommunicerad?

- Precis när ”incidenten” inträffar.
- Kort efter den begärs,
- En längre tid efter den begåtts,
- När trafiksituationen inte kräver förarens fulla uppmärksamhet (ex. raksträcka),
- I slutet av körningen när bilen står stilla,
- En sammanfattnings i slutet av månaden/året,
- Beroende av typ av situation som återkopplingen är kopplad till,
• När föraren själv begär det,
• Annat?

Förklaring: Även om återkopplingen tekniskt sett skulle kunna förmedlas direkt till föraren, är det inte säkert att detta är lämpligt av olika anledningar.

**Tema Hur ska det kommuniceras**

På vilket sätt bör återkoppling kommuniceras?

- Exempelvis talande röst och eller skärm, vibrationer.
- En mix?
- Det kan sitta andra i bilen. Integritet.
- Typ av incident och tid för återkoppling gör att olika medium kanske lämpar sig bäst.
- Funktionsnedsättningar. Dålig syn, hörsel etc. i åldersgruppen äldre.

Förklaring: När man undersökt vad återkopplingen ska bestå av och vilken tid den ska kommuniceras, kan det vara relevant att undersöka i vilken form den ska kommuniceras. Olika medium kanske passar bäst i olika sammanhang. Preferenser kanske spelar en avgörande roll. I vilket fall sätter funktionedsättningar associerade med åldrande ramar för hur systemet till slut formas.

**Tema Systemets personlighet/intensitet**

Bör systemet uppfattas som påträngande, passivt eller något däremellan?

- Bör det vara, positivt eller neutralt eller negativt?
- Bör det vara anpassat efter vem föraren är?
- Om anpassning inte går, vilken personlighet skulle kunna vara utgångspunkten.

Förklaring: Frågorna i detta tema handlar om vilken typ av trafikläsare som man vill ha; å ena sidan en som är påträngande och ger återkoppling på all körning som devierar från det trafiksäkra, eller en passiv trafikläsare som kanske bara återkopplar vissa solkla missar som föraren begår körning efter kröning. Bara för att instruktören vet vilka fel som begås, betyder inte det att ha på direkten behöver göra föraren medveten om det.

**Tema Acceptans och tillförlitlighet**

Skulle ni kunna tänka er sådant här system i bilen?

Skulle det uppfattas som irriterande eller hjälpande?

Tror ni att systemet skulle hjälpa förare till säkrare körning?

Hur skulle era åsikter förändras om systemet ibland gav missvisande återkoppling?

Förklaring: Tema Acceptans och tillförlitlighet är fokuserar på huruvida äldre förare känner att systemet skulle kunna fylla någon nytta och vad denna nytta skulle kunna bestå av. Vidare undersöker det hur föraren ställer sig till systemet när det av någon anledning ger felaktig återkoppling.
Appendix D

An example
- Using a visual interface to implement the metaphor.

Scenario
- A person has driven from location A to location B. During the drive he compromises safe driving behaviour in an T-intersection. In this example, he gets feedback on his driving after he reaches location B.

Diagram 1

Diagram 2

Diagram 3

Diagram 4

Diagram 5
Appendix E

Transkribering - Gruppintervju med f.d. trafiklärare

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<td>5 Moderator</td>
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5 Presentationsliden

4 40-44 kör man säkrast. Då har man mognat och släppt prestigen.

3 Man borde inte få ta körkort innan 25 års ålder.

1 och 4 Känner igen sig och pratar den sämre synen som kommit med åldern. Glasögon, vindruta plus om det regnar och är mörkt och svart asfalt gör det svårt att se. 1 Beskriver hur hans fru ser ”koronor” runt varje ljus. 4:s fru är likadan och vill inte köra när det är mörkt.

2 Med progressiva glasögon blir det svårt iblanda att köra.

4 Det står inget om hur fort de kör?

5 Nej, tyvärr.

4 Om man ska ha ett flygcertifikat så måste man ha ett visst antal flygtimmar per år för att bibehålla certifikatet. Ytterligare ett för att få flyga i mörker.


3 Det räcker nog inte med en lektion


4 Jag åkte taxi i Singapore. Och då började plinga i taxin när han körde över gällande hastighet.

5 Det där är en form av ”direkt återkoppling” som kommer tätt intill på det inträffade felet. Tror att folk skulle acceptera ett system som så aktivt ger återkoppling? Man kanske ska vänta att ge återkoppling till efter körningen, eller veckovis, eller månadvis? Passivt snarare än aktivt.


5 Vi säger så här, givet att teknologin finns för att märka av vad som är rätt hastighetsanpassning, givet att tekniken ”ser” vad trafikläraren ser, om det kunna bedöma vad som är lämplig hastighet i olika situationer, för föraren att hålla, hur tror ni att ett sådant system skulle kunna se ut?

Men om bilen skulle kunna ”se” så skulle man kunna kommunicera exempelvis ” nu närmar du dig ett obevakat övergångsställe, tänk dig för”.

Jag vet inte om man skulle lite på det riktigt.

nu ska vi inte vara så gammalmodiga. Vi har ju tillverkat en bil en gång i tiden.

Ja, det kommer nog så småningom.

Det är ju ofta damer som kommit i åldern som kört väldigt lite. Och mannen är eventuellt sjuk och kan inte köra mer.

Jag vet en dam som skulle köra till sin sommarstuga norr om Roxen från staden. Men hon ville inte åka någon annan stans.

Är man yrkesskadad som trafikläsare? Hur är det när man åker med andra utanför yrkes- praktiserandet?


Man kan ju ta och åka igenom samma ställe igen. Tyvärr är det då inte samma trafiksituation den gången.

Tänk om målet inte är primärt att köra trafiksäkert utan att bli bättre över tid. Det är frivilligt.

Men tänk om föraren inte tittar åt höger i en korsning, och där kommer en bil, då är det ju en olycka? Det skulle ju behöva vara ett system som säger att kolla nu ordentligt åt båda hållen här.

Annars kan ju olycka hända, vad för nytta spelar återkopplingen då?

Om en elev inte kollar dit denne bör i en trafiksituation så gripa vi som trafikläsare in. Vi hoppar på dubbelkommandot. Men vi säger ju inget innan utan vi vill ju att dom ska klara det själva. Ibland valde man en rutt för att dom skulle få möjlighet att träna på en speciell sak, exempelvis döda vinkeln.

En av orsakerna till att man inte kollar överallt kan vara att dom mest bry sig om vart dom ska.

Sådana system som finns ju också som aktivt ser till så att säkerheten upprätthålls. Men här är frågan ett system som ska försöka se till så att situationerna inte uppkommer där dessa ingripanden behövs.

Man försöker ju ingripa så sent som möjligt så att dom ska få chansen. Alla instämmer och beskriver att man inte får ingripa för tidigt.

Man måste ge dem utrymme för att få in rätt känslor för vad som gäller.

Vilket medium skulle passa för återkopplingen, ljud eller bild eller vad tror ni? Och när skulle det passa med tanke att det ska in i vanliga bilar där folk med körkort sitter.
4 Vi åker ju tillbaka till brottsplatsen. *Alla håller med om att det är den bästa återkopplingen*

1 Det är den bästa återkopplingen man kan göra.

3 Med en gång bör det göras.

2 Det kan vara bra att dem får återkoppling som ger lite eftertanke, så kan det kanske flyta på bättre med körningen sedan.

5 Hur sker återkopplingen i och med att ni låter dem åka tillbaka och köra om situationen?

4 Ja man kanske inte behöver ingripa men beteendet var tokigt. Och då kan man ju fråga om dem tyckte att de gjorde rätt eller fel i den där korsningen eller vad det nu var. Och om då inte har någon susningen om vad som gjorts fel, då åker vi tillbaka.

Det är viktigt att poängtera att beteendet ska vara samma oberoende vilken korsning eller rondell man kör i.

2 Samtidigt så i en lektion har man uppdelat vad som ska gås igenom under lektionstiden. Och en typ av situation kan ju inte ta hela lektionstiden. Utan det återkommer man till i mån av tid, efter att allt har hunnits med så som förutsatt. Annars kan eleven känna sig väldigt oduglig.


2 Tyvärr har vi fasta bilder. Det skulle ju vara önskvärt att bilderna rörde sig.

3 Jag vidhåller att det är en sak att lära sig att köra i Linköping, men åk bara till Motala så är det inte alls sig likt. Okända platser är svårt för oss.

2 Berättar en historia om et äldre par där mannen var svårt sjuk och frun tvingade sig själv att köra mer och mer även om hon var ovan. Dem ville inte hamna i en sits där dem inte kunde åka någonstans och bli tvungna att sälja sommarstugan. Det finns nog många i den kategorin som kör fast de egentligen inte vill så att säga. Man kör för att man vill kunna upprätthålla en viss livsstil.

3 De som inte kört på länge eller med lång tid emellan gångerna borde inte köra bil. Förr i tiden räckte det med att köra lite lastbil i en inhågnad så fick man körkort för det. Dom fick körkort för tung lastbil.

2 Nej så var det inte. Man kunde genom intyg få D-kort exempelvis.

4 Förr i tiden fick man ju körkort för motorcykel när man tog bilkörkort.

3 Generellt så tror jag inte att dem som inte kört på länge kör något.

2 Men som damen som jag berättade om så finns det fall ändå.

5 Jag skulle vilja att vi försökte återgå till temat med återkoppling på körningen.

4 Jag tror ju på munligt återkoppling i bilen. Tror jag är bättre än bild. Kombinationen bild och ljud är ju så klart ännu bättre.

1 Ja både och hade varit det bästa.

5 Om vi som exempel tar en resa upp till Sälen, när skulle återkoppling på felaktig körning komma?
Jag tycker att den borde komma kontinuerligt.

Men tänk då om du kört i 40 år utan återkoppling och så får du det plötsligt hela tiden samtidigt som om det sitter flera andra i bilen så kanske det känns som ett personligt påhopp?

Jo, det har du nog rätt i.

Jag kommer ihåg min far som fick fel på ögat. Då sa jag att du kanske ska sluta köra bil då. Nej, jag har kört bil i hela livet. Även om han kanske innerst inne visste att han inte var så duktig så ville han aldrig erkänna det.

Min äldsta brorsa sa att jag skulle åka med farsan.

Det är så svårt att säga åt sin far, och då sa jag åt läkaren att nu ser vi till att ni tar hand om körkortet. Då sa läkaren att då får du vara med vid utskrivningen.

Läkare vågar inte, vill inte bli ovänner med folk.


Det kan ju vara att man själv inte är medveten om att man kör illa. Dom kanske tar bilen oh kör själva, och om dom då inte får någon återkoppling så finns det ingen som säger åt dom.

Då kanske det finns själv att ge sådana återkoppling?


Jag tror det är ett känsligt ämne huruvida man egentligen ska köra eller inte. Det är få som säger till någon annan upp i åldern att den borde sluta köra.

Det finns mycket prestige i bilkörning.

Du kan ju tänka dig om du kört bil i mer än halva livet och sedan kommer någon utifrån och säger att du inte är riktigt kapabel till det längre. Det är svårt.

Det är för lite krav på körkortstrafikanter. Det begärs för lite.

Det är vanligt att han kör för jämnna. Hon kör kanske när dom ska på fest. Och då kör hon jättebra, säger han efter ett par järn.

Tror ni att om den mest hårdbarkade personen får återkoppling på ett sätt som inte är angripande, så kanske det ger med sig efter ett tag? Om personen vet med sig att ”det här systemet reagerar på min körning om tycker att saker och ting inte är bra med körningen”. Ger det till slut med sig?

Det måste komma från en person med lite under fotterna då, som har jobbat som vi då. Min kompisar lyssnar ju – när de väl frågar mig.

Vad jag förstår så är det inte lätt med frivillighet inom vår bransch. Utan det måste kanske komma uppifrån, att dom måste.

samtidigt är det ju det vi sitter här för, att man inte ska behöva köra halvt ihjäl sig innan man vaknar till. Där ska ju det här hjälpmedlet fylla en funktion.

3 Bara bilder tror jag inte på för att återkoppla.

2 Ljud har nog sina fördelar.

5 Jag kan tänka mig att bild har fördelen att man kan visa att det var här det skedde, som din helikopter-karta (person 4). Jag tänker att det blir svårt att minnas allt om man bara får det i tal.

4 Javisst. Rent konkret behöver bild till också då. Och att man pratar till bilderna.

3 Filmer har vi visat allihop, då förstår människor. Men sedan när man ska köra, så är den informationen lite borta ibland.

2 nej inte enbart, men i kombination med praktisk träning så har det ju effekt.


2 Nu sa ju du att det var för äldre förare. Men det går ju inte att säga till äldre att “nu är du 65 och behöver en sådan här bil”.

5 Det kommer nog inte marknadsföras så heller. Utan kanske lanseras som ett extra tillval.

3 *Börjar prata om en bussolycka som kan ha haft att göra med att en förare var distraherad av sin mobil innan olyckan inträffade*.

5 Om vi tar mobilanvändning som ett exempel. Föraren använder mobilen, och även om detta inte leder till en olycka den gången så har det inneburit en förhöjd risk. Hur skulle man kunna återkoppla det? Och när?

2 Det är ju en sådan liten klick som försöker sig på att hanka sig fram i alla fall. Det är ju dom som skulle behöva ha hjälp bland de äldre.


2 Om vi pratar om bussolyckan. Hade vi haft teknik i det där sammanhanget. Då kanske inte det hade skett. Det är ju precis som med läkare; när de har gjort fel och någon har dött, så säger man att man ska förbättra något, men då är det en som har fått sätta livet till innan man förbättras.

3 I framtiden tror jag att det som behövs är helt automatiserad körning eller tvingad fortbildung.

2 Idag är det ju bara folk som tvingas till det som utför fortbildung. Efter sjukdom.

3 Jag tror att alla, oavsett ålder skulle må bra av återkoppling.

4 Ja, hur bra eller dåligt kör jag.

3 Ja var tionde år eller så, eller helteknik.
2 Vi skulle alla behöva återkoppling, inga av oss kör perfekt. Det var ju till exempel ett under att vi tog oss hit (kollar på 1 som körde till intervjuomötet).

2 Vi kanske inte skulle tala så bra, påpekande från någon annan.

3 Man vet inte hur man skulle reagera.


1 När återkopplingen ska komma. Det är ju jätteviktigt. Kommer du själv ihåg vilken återkoppling du fick från körkortstiden?

5 Nej, det var ju ett par år sedan nu och jag har glömt av vad som återkopplades. Kanske att min mor säger till en att man kör för fort.

4 Det är ju en förutfattad mening, om man har körkort så ska man veta om regler och hålla sig uppdaterad också. Men det får man kommentarer om att "Jasså, är det så nu, har den regeln blivit ändrad?". Där har vi också en aspekt, att folk kör fel enligt reglerna. En person kan ha tagit körkort för 40 år sedan. Och har liksom inte tittat på reglerna som ändrats.

1 Uppdatering kring regler i trafik är ju obefintlig alltså.

5 Hur är den uppdateringen tänkt att ske?

2 Vi har ju märkt extra tydligt när kravet om att man ska utbilda sig till handledare kom. Då kom folk fram och tackade när de fick uppfärschat vad som gäller.

2 Dessutom hängde dom med när vi tränade med deras barn. Det var ett plus. Då fortsatte dom träna på de aspekter vi träna på i körskolan. Istället för att studenten kom hem till mor och far och sa att allt gick bra, så fortsatte man alltså träna på svaga punkter.

1 Pratar om att polisen emellanåt har mindre trafikkompetens än trafikläraare och att han ibland har satt dit dem.

2 Kommer ihåg när min pappa sa att jag kanske inte skulle klara av att köra en sträcka en gång. Då sa han: "Men du har ju körkort". Det var som om det var beviset att jag skulle kunna alltling.

Sedan tror jag att ju mer teknik vi får hjälp av desto mindre behöver vi själva tänka.

4 Jag tror på kurser, både teoretiska och praktiska kurser. Får medhåll av nummer 3.


2 Jag hade en elev vars mamma hade krockat på grund av ett rent kunskapsglapp. Hon hade kört på en relativt bred väg som korsades av småvägar. Där gällde högerregel men i och med att vägarna som korsade den breda vägen var mindre så trodde hon att hon hade företräde. Efter det så fick hon det var på vitt, det kan ju också ses som en slags återkoppling.

5 sedan finns det ju en lagparagraf som säger att i korsningskörning så ska man köra med särskild försiktighet.
3 Det finns också en problematik i att principerna vid bilkörning är samma från plats till palts. Men i exempelvis en ny stad är ingenting sig likt från den man är van att köra i.

2 Körmiljö har stor betydelse.

3 Det gäller att ha huvudet med sig när man kör i nya miljöer.

4 Speciellt äldre har svårt med nya komplicerade situationer. Jag har mött äldre personer i rundeller körandes i fel riktning tre gånger. De kör in i rundellen och svänger vänster med en gång, ut mot färdriktning. Det har varit äldre personer alla tre gånger.

3 Där skulle det varit ett system som stoppa det där beteendet.

Han fick till slut körkort genom att övningsköra med sin far. Han gifte sig och körde ihjäl både sig själv och sin fru i sportlovet utanför Gävle. I samband med snö och halka. Han var nonchalant.

2 För vissa räcker det inte med prat eller bilder.

3 Kontinuerlig fortbildning eller helsystem.

5 Om vi återgår till en tidigare diskussion, vad ska kommuniceras till den äldre bilföraren?

3 Man måste vara försiktigare när man ger återkoppling till erfarna förare.


Kan vi anpassa återkopplingen till dessa som kör fåtalet gånger och inte så bra?


4 Ja sådana som kör mycket och räddas utav andra. Så är det ju, många gånger anpassar sig andra efter någon som kör illa.

2 Givet att dem upptäcker en situation där de har felat, så tror jag att eftertanken kommer smygande vilket till slut leder till insikt i vad som gjorts fel och vad som behöver rättas till.

1 Skulle du vilja att vi bedömde din körning?

5 Ja, det hade ju varit intressant men det hade blivit många fel.


3 Vi kollar först av vad föraren kan, innan vi bestämmer vad som ska övas på, så att det blir effektivt. Men många tycker att vi är i vägen för körkortet. Att vi kostar pengar.
4 *Visar ett klipp på en olycka som han använt i avskräckande syfte för sina studenter om vad som kan hända vid halka."

Tack för den här fortbildningen du!

5 Tack detsamma. *Intervjun avslutas*

**Transkribering - Gruppintervju med slutanvändare**

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4 Presentationsliden

3 Det brukar vara min fru som gör det här jobbet (syftar på återkoppling)

*gruppen är road av uttalandet*

5 Jag skulle precis säga samma sak.

4 Vad brukar din fru påpeka?

3 "Fan vad du kör illa". Nej, jag skojar, så brukar lägga fram det på ett annat sätt.

1 Finns det någon skillnad mellan könen upp i åldern när de kör?

4 Det finns en trend där kvinnor slutar köra innan de egentligen behöver. De har dåligt förtroende i sin egen körning. Män har en annan trend, där de kör över sina förmågor å andra sidan.


4 Det finns fortfarande röster som förespråkar uppfräschningskurser.

2 Ja, jag tror det skulle vara bra faktiskt.


1 För det sker stora förändringar när man blir gammal. Jag märker ju själv när jag kör när det är mörkt att jag har sämre mörkerseende.
2 Ja verkligen (syftar på mörkerseendet), och regnar det dessutom.

6 Ja det är betydligt svårare nu för tiden.

4 Anpassar ni körningen efter det här?

1 Ja, oja.


3 Jag vet inte om det är att man blir kinkig nu på äldre dagar. Men säg att man kör i 100 och så kommer det någon och svischar förbi. Då blir man irriterad. Man ska ju inte hetsa upp sig i trafiken. Men man blir ju irriterad. Är det bara jag?

5 Jo men det blir man, lite grann så där.


3 Var det en informationsskylt eller?

1 Nu har du ju kommit vägsträckor med nya hastighetsskyttar också så nu vet man ju inte vad det är för hastighet som gäller biland. 30, 40, 60, 70, och 80 – det finns alla möjliga hastighetsskyttar. Det är därför jag är inne på det här med utbildning när man ska hämta ut sitt körkort. Så får man sig en uppdatering.

2 Det förslaget jag berätta om förut handlade just om en sådan utbildning.

3 Finns det inte någon app med senaste trafikteorin?

5 På tal om det här systemet så tycker jag att återkopplingen borde komma med en gång. Precis när man har gjort felet.

4 Skulle du fortfarande tycka det var en bra idé att kommunicera direkt med tanke på om det eventuellt sitter andra i bilen eller att det kanske stör körningen?

5 Jo det kanske inte är så uppskattat.

2 Det får mig att tänka på GPS-rösten jag har i bilen som hela tiden tjatar om hur jag ska köra.

5 Jag tänker på det här med skyttar så finns det ju faktiskt stödsystem som läser av skyltarna. Det är ju jättebra så slipper man den delen av körningen.

1 Det finns en problematisk i att det är upptäckt av kommunen och de sätter dom hastighetsgränserna. Det kan man se om man kör på en vägsträcka och så blir det helt plötsligt en ny hastighetsgräns.

3 Jag tror det är kommunen som sätter dom gränserna.

4 Vi pratade om era fruar förut, att dem ger er återkoppling. Hur ser den återkopplingen ut?

3 ”Det är femte här vet du väl, och du kör i 60″.
4 Hastighetspåminnelse är nog ganska vanligt.

3 Ja det är det ju.

4 Hur reagerar man på den återkopplingen?

6 Ja då bromsar man ju in, annars blir det ju mera diskussion.

3 När det finns hastighetskameror på vägarna så brukar hon ju vara med och säga till mig att ha uppsyn efter dem.

5 Som du sa där förut så kan man ju reagera olika på återkopplingen man får. Man kan ju bli irriterad bland annat.

4 Hur hade det varit om frugan väntat med att ge återkopplingen till efter körningen?

3 Då hade man ju glömt av och inte kunnat koppla vad det handlade om.

*de andra håller med om att det i sådana fall skulle vara borta*

3 Sedan kör man ju inte medvetet för fort, utan det händer.

2 Och jag tror det där hänger upp med mängden skyltar som kommit på sista tiden. Man vet inte vilket hastighetsgräns som gäller längre.

1 det här första klippet du visade men han som inte var i rätt fil och kollade på skyltarna i himlen. Det blir ju svårt när man är på en ny plats och ska försöka med att både läsa skyltar och samtidigt ha koll på var bilen ska vara på vägen. Man hinner inte med alla gånger.

*diskuterar det uppfattade uppdrivna tempot i stadsmiljökörning*.


4 Det kan ju slå fel kan jag tänka mig. Exempelvis med övningskörningsskyltar och andras bilisters behov av att köra förbi sådana.

5 Jo det är nog många faktorer som avgör. Men just det här systemet som läser av hastighetsskytter tycker jag är jättebra.

3 Finns den att köpa som tillbehör till bilen eller?

5 Ja det finns.

4 Hjälper era fruar till i fler situationer, till exempel när ni parkerar eller när ni kör i korsningar?

3 Nej, det tror jag inte min gör.

6 Jo ibland när man parkerar.

5 ”Nu kommer du för nära”.

3 ”Kör inte för nära häcken nu för då får du repor på bilen”, brukar hon säga.

2 Jag tror att det beror mycket på huruvida den andra parten kör bil eller inte.
4 Presenterar use case scenario

5 Skulle det vara någon form av utrustning som då skulle se vartåt man kollade?

4 Ja precis.

3 Vad finns det för återkoppling på mobilpratande i bilen?

6 Det måste det göras något åt tror jag. Det beror ju förvisso också på var man är. Om det är på en lugn landsväg så lämpar det sig bättre att svara än om det är i rusningstrafik.

2 Det ser man ju mycket i Stockholm att var och varannan sitter med mobil i handen medan de kör.

5 Det är ju ännu värre när man sitter och skriver sms.

1 När i tiden ska återkopplingen ske? Är det föraren som ska begära det då eller?

4 Ja, vad tycker du? Skulle man själv trycka fram återkopplingen eller skulle den vara automatisk?

1 Ja, det táls ju att tänka på. Om han gör fel i körningen och får det där i ansiktet hela tiden. Inte blir man en bättre bilförare då.

5 När man har stannat skulle det kunna vara ett ”pling-pong” och vet man att systemet har några synpunkter på sin körning sedan man startade. Och då måste man kunna ta åt sig det, att man har gjort fel.

1 Ja tror att det blir bäst att man trycker fram det själv, när man vill ha synpunkten så att säga. Risken är ju att man inte känner för att göra det. Att man inte trycker fram det någon gång.

3 Givet att det går att spåra körningen så här så finns det ju risk för en möjlighet för någon typ av storebroövervakning.

2 Parallellt med det här systemet, finns det någon som kollar på hur cyklisterna beter sig?

3 Ja precis, jag tycker att cyklister, t.ex. studenterna här på campus, borde ha en cykelutbildning när de introduceras till Linköping. Inte bara att man lär sig hitta utan också hur man ska bete sig i trafiken.

4 Som vadå till exempel?

3 Cykla i bredd på cykelbanor till exempel. Det kan komma tre stycken som cyklar bredvid varandra och så kommer man som mötande och blir nästan uträngd.


5 Men det är ju ditt ansvar, du har ju välningsplikt i det fallet.

2 Jo så är det, men det är svårt att se dem när de kommer snabbt. Man kan ju ställa sig frågan varför det är grönt för dem samtidigt som för biltrafiken. Ibland lyssnar dem ju på musik också, då är det ännu högre risk.

3 De är snabba vet du. Man tvingar sig förbi bilar.
Pratar om gamla minen när anställda på Saab cyklade till och från arbetet utan att bry sig så mycket om resterande trafikanter.

Pratar om krav för att få framföra militärfordon på allmänna vägar

För att återgå till återkopplingssystemet, hur ställer ni er till ett sådant system?

Jag vet inte om man är direkt sugen på att köpa till tekniken som tillval, hur skulle det går till undrar jag? Jag har ju en äldre bil.

Det är väl mer troligt att nya bilar utrustas med det. Och då handlar det ju så klart om hur mycket ett sådant system skulle kosta kunden.

Man skulle ju kanske inte köpa en ny bil bara för att kunna få återkoppling.

Ja och sedan kanske det inte tillhör standardutrustningen.

Finns det här i nya bilar?

Nej, det här är bara på pappret.

Det skulle ju vara mer positivt om det ingick som standardutrustning.


Det kan ju vara lite svårt att ta till sig ett sådan här systemet för det är ju inte direkt olycksförhindrande så att säga. Det gäller ju att plantera det på något sätt så att det ändå används.


Ja då blir det ju dålig stämning.

Det är bara bagateller, det är bara att åka vidare.

Ibland felar ju teknik tyvärr.

Jag har ett system i bilen som jag tycker är bra. Det varnar innan det dyker upp fartkameror.


Det finns som sagt bara på papper idag.

3 Sedan finns det ju andra själ till varför folk dör som ligger utanför trafiken. Trafiken har ju blivit säkrare och säkrare med åren. Men det finns annat viktigt också.

2 Det beror ju på flera faktorer. Både bilarna och infrastrukturen har ju blivit bättre.

3 Se exempelvis på alkoholistar och folk som brukar narkotika. De diskuteras inte inte i lika hög grad. Vi sitter här och diskuterar vanliga förare. Samtidigt som påverkade är ute i trafiken och kör. Hur ska man få bort ur trafiken?

1 Ja det är ju viktigt med sådana här feedback-system förvisso men det finns ju andra problem i trafiken också.

5 Det väl egentligen bara att lägga ett lagkrav på alkolås i bilarna.

1 Jo, men sedan kanske folk lär sig hur man ska komma runt sådana system, att man lurar dem.

*gruppen diskuterar nykterhetskontrollerna i hamnarna i Göteborg och Stockholm hamn och rattonykterhet i allmänhet*.

*gruppen diskuterar svårigheterna med lampbyten i olika bilmodeller, ljus på lastbilar, taksökare som förbjöds på grund av risken att skada fotgängare vid krock*.

4 Vi pratade om registreringsskyltar som indikera var man kom ifrån förut, och nu var vi pratat lite om taksökare som fanns på bilar förr i tiden. Kommer ni på något annat som försvunnit med tiden men som ni uppfattade som användbara?

*gruppen diskuterar för och nackdelar med att kunna identifiera hemort med hjälp av registreringsskylt*.

4 Nej, annars kan jag inte komma på något.

1 Nej, inte jag heller. Vi körde ju på vänster sida förut men de har ju ändrats.

4 Var ni ute och körde den dagen?

6 Jajamän. *andra hummar instämmande*

4 Hur såg informationen ut innan införandet?

3 Det var en intensiv kampanj.


3 Man satte upp skyltar längs med vägarna.

5 På TV hade man ju också kampanj. Sådana kampanjer ser du inte i dag när nya trafikregler kommer. Till exempel det här med fotgängare gick nog många förbi som hade körkort lågt innan den regeln togs i kraft.

5 Sedan fanns det ju även en kampanj om att man att alla i bilen skulle ha hjälm på sig. Det var NTF:s ordförande Hammarlund som propagerade stenhårt för det.

3 Sedan kom säkerhetsbältet.

*gruppen diskuterar och jämför nya och gamla bilkonstruktioner*

5 Då börjar det här lida mot sitt slut.
3 jag tror att det här med återkoppling är en bra grej. Och sedan det här med kontroller för förare innan de hämtar ut ett nytt körkort.

1 Ja det är bedrövligt att man inte fått ordning på det där än.

3 Man sjunker ju gärna in i sin egen rytm och beteende utan att man tänker på det. Och som då kanske är felaktigt.

5 Tack för att ni kom.

*Intervjun avslutas*
Upphovsrätt

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