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Feedback intervention for senior drivers (I)

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Preface

More and more elderly people live in Germany. The now aging cohorts were mobile by car most of their lives and so the everyday lives of many older people are geared to car use. In old age (around 75 years and older), however, the risk of causing an accident with personal injury increases (Figure 1).

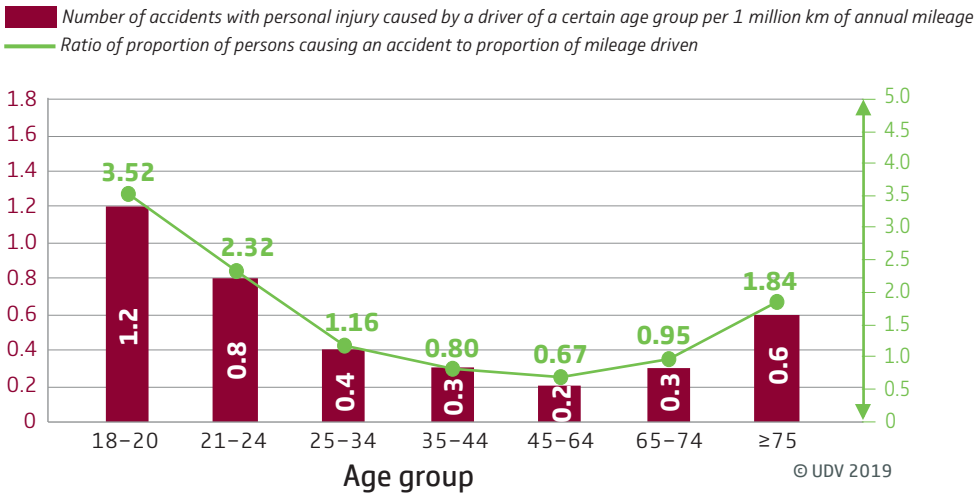
Senior drivers often cause accidents with personal injury at intersections, when yielding or disregarding right of way and priority, when turning off from a road, driving backwarts, turning, entering traffic, and driving off [1]. On the other hand, driving at unadapted speed, exceeding the speed limit as well as driving under the influence of alcohol or drugs occur much less frequently than in all other age groups.

Starting at an age of about 70 years there are a multitude of (non pathological) changes in physical and mental performance, which can also affect driving skills.

- Visual functions deteriorate. This concerns visual acuity, dynamic visual acuity, accommodation (near/far), glare sensitivity, contrast sensitivity, etc.
- Attention control deteriorates. Visual search, selective attention, divided attention, inhibition of irrelevant information, etc. may be affected. Problems with attention control can lead to increased distractibility.
- The speed of performance in the area of perception and action decreases.
- Physical flexibility and resilience decrease.
- Due to greater effort required to deliver the same performance, stress may increase.
- Complex performance demands under time pressure increase the risk of sensory, cognitive and/or motor overload.
- Older people often act based of their experiences and their expectations with regard to situations and behaviours of others. This strategy is often successful, but not in unexpected, rare, critical or unknown situations.

Mileage-related risk of a driver of a certain age group to cause an accident with personal injury

Figure 1



**own calculations based on the datasets of infas, DLR, IVT and infas 360 (2018) as well as Statistisches Bundesamt (2018)*

- The unfavourable changes in age are often gradual and difficult to perceive for those affected. They are also reluctantly perceived. Hints at age-related changes are sometimes perceived as an insult. This can lead to an excessively positive picture of one's own competences, which hinders critical self-reflection.
- With increasing age, the probability of suffering from one or more illnesses also increases, which is often accompanied with taking medication.

The process of ageing therefore requires seniors to make strong adaptations, also when driving a car.

At present, there are a large number of road safety measures that help older drivers to adapt their driving behaviour and maintain car mobility in the long term. These measures range from moderated group events (in which mainly knowledge is imparted or refreshed), through medical and psychological examinations to feedback interventions (single rides in real traffic accompanied by specialists and followed by subsequent qualified feedback) and driver training. Participation is generally voluntary.

Driver training has proven effective in maintaining and improving driving skills (e.g. [2], [3]). Driver training, however, is very effortful and only very few drivers take advantage of it. This raises the question of less costly but still effective measures to maintain and improve driving skills. An essential element of effective training is well-founded feedback from an accompanying person. This feedback can help to improve the self-assessment of one's own driving competence and to support an appropriate adaptation of one's own driving behaviour. Obtaining **qualified feedback** on one's own driving competence can thus be a first step into dealing with one's own driving competence.

The study was conducted on behalf of the German Accident Research (UDV) by the Institut für Verkehrspsychologie (IVP), Aachen. Also involved was TÜV/DEKRA arge tp 21, who provided advice on the technical implementation and programming of the Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA). The DEKRA branch office in Dresden provided one of the two accompanying persons for each of the trips.

Project aims

In this study a measure for qualified feedback on the driving competence of senior car drivers is developed and evaluated. The target group of the present study are drivers aged 75 years and older who have not become delinquent in road traffic so far and for whom there is no doubt as to their fitness to drive.

This feedback intervention consists of an accompanied ride in real traffic, in which the driving behaviour is systematically observed and evaluated. Subsequently, feedback is given on the basis of these observations and information on possibilities to maintain and improve driving skills is provided.

A qualified feedback should identify strengths and weaknesses in the observed driving behaviour and point out discrepancies between self-assessment and external assessment of driving behaviour. It is supposed to motivate the driver to reflect critically on his driving skills and give concrete recommendations on how he can maintain or improve his competency.

The results of the feedback intervention do **not** have consequences on own‘s possession of a driving licence. Such a feedback intervention is **not** meant as a test of competence that people take in order to obtain a car driving licence.

Project documentation

The results of the project are documented in two reports:

1. The **UDV research report no. 60** [4] documents the procedure for the feedback intervention that was developed in the course of this project. The central focus is on the Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA) in its revised version from the year 2019. With the help of this tool, the driving competence of senior people can be observed and evaluated systematically. The report also contains instructions on how to conduct the feedback conversation.
2. In the **UDV research report no. 61**[5] the scientific principles of the feedback intervention are documented as well as the methodology and the results of the evaluation of the effectiveness of the feedback intervention.

Both reports are available for download on the website of the UDV (www.udv.de).

Feedback to improve driving competence

A study commissioned by the UDV has shown that senior car drivers are seldom spoken to with respect to changes in their driving behaviour [6]. If at all, this is most likely done by family members, less often by people of the same age group. Factors that hinder providing feedback are the fear of hurting the person concerned and the view that the assessment of one's own ability lies in the individual's personal responsibility. Senior drivers themselves indicated that they would like to receive feedback, especially from external experts, e.g. their family doctor. However, this seldom happens in practice so far.

Feedback is generally considered to have a high potential for influencing behaviour. From research on learning the following requirements for effective feedback can be derived:

- Feedback should not only address mistakes and weaknesses, but also point out the driver's strengths and competencies.
- Negative and corrective feedback should be complemented by positive, confirmatory feedback appropriately.
- Corrective feedback should only be given on behaviours that the driver is able to change (counter-example: looking over the shoulder with pronounced neck stiffness).
- Beneficial for the acceptance (and the effectiveness) of feedback is the reference to concrete traffic situations.

Feedback should encourage the driver to reflect on his behaviour as well as the reasons for it and stimulate the consideration of alternative behaviours.

Feedback intervention

The feedback intervention has been designed with low time and cost requirements for the drivers. It is supposed to be a low-threshold offer. Therefore, the feedback intervention consists of only one trip with subsequent feedback. A total duration of about 45 minutes is aimed at, corresponding to one driving lesson in a driving school.

The route for the feedback intervention is supposed to contain a variety of potentially critical driving situations relevant for senior drivers. These include, for example, driving through complex intersections, turning left, merging, and crossing cycle paths and sidewalks. The route in this study mainly ran through urban areas (Dresden city area), but it also included a short ride on the highway heading to and from the freeway (Autobahn 4) close to the city as well as a short ride on this freeway. The route included intersections of all kinds as well as a (newly established) roundabout.

A feedback intervention can be undertaken in the drivers own car or in the car of the accompanying person, which is equipped with dual controls. A car with dual controls allows the accompanying person to intervene if a particularly critical driving situation occurs. The use of the drivers own car ensures closeness to everyday life and avoids driving errors that stem from getting used to an unfamiliar car.

As qualified experts who can accompany the ride, all professional groups involved in the observation and assessment of driving behaviour can be considered. These include driving instructors, traffic psychologists, officially certified experts or examiners and driving safety trainers. However, when observing driving behaviour and providing feedback to senior car drivers, special skills and experience with the difficulties of senior drivers are required. Particularly with respect to the feedback given, there are differences compared to, for example, feedback that is given to novice drivers or to drivers who have become delinquent in road traffic.

The Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA 2019)

The Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA) [4] was developed to systematically observe, evaluate and give feedback on the driving skills of older persons in real traffic. It is a generally applicable, objective and highly practicable observation instrument which allows for differentiated evaluation of and feedback on the driving skills and road safety of senior drivers. ERIKA consists of several components:

- **catalogue of driving tasks** to describe observed behavior at concrete driving tasks
- **observation sheet** for regularly recurring observations,
- **scheme for evaluation**
- **approach for giving feedback**

The individual components of ERIKA are ideally transferred into an electronic observation and feedback tool for mobile devices. This tool helps the accompanying person to carry out the observation, evaluation and feedback. The conduct of the feedback intervention is thus standardized to a certain degree, which ensures objectivity and high quality in conduct. In addition, the recording and evaluation of driving competence becomes transparent for the participants. This increases the probability that also negative feedback will be accepted and reflected by the driver.

Driving tasks, observation and evaluation scheme

The heart of ERIKA is the catalogue of driving tasks. It describes the four driving tasks particularly relevant for senior drivers as well as how senior drivers cope with them. The **four driving tasks** and their respective subcategories are:

1 enter traffic, merge, leave a traffic stream, change lanes, pass, overtake
1.1 enter traffic, merge, leave a traffic stream, change lanes
1.2 pass
1.3 overtake

2 driving route (straight on and curves) (no second level)

3 intersection, junction, roundabout, rail traffic
3.1 crossing intersections (differentiation: left yields to right/with right-of-way sign/with traffic light)
3.2 turning right at intersections, junctions and roundabouts (differentiation: left yields to right/with right-of-way sign/with traffic light/roundabout)
3.3 turning left at intersections and junctions (differentiation: left yields to right/with right-of-way sign/with traffic light without left-turn signal/turning left with left-turn signal)
3.4 rail traffic (where applicable)

4 pedestrian crossing, bus or tram stop
4.1 crossing pedestrian crossings
4.2 driving past bus or tram stops

The conduct of these driving tasks is observed with regard to the following **three aspects**:

- traffic monitoring
- communication, distance, vehicle position
- speed adjustment

There are **three evaluation** categories available for judging the behaviour during a driving task:

- particularly careful driving behaviour
- socially tolerated driving behaviour
- faulty driving behaviour

„Socially tolerated driving behaviour“ refers to behaviour that is common on German roads and complys with the requirements of traffic flow, but which is not fully consistent with road traffic regulations.

Figure 2 shows the three evaluation categories using driving task number 1.1 „Enter traffic, merge, leave a traffic stream, change lanes“ and the aspect "traffic monitoring“ as an example.

To check the objectivity of the instrument, the agreement between the two trained observers who accompanied the senior driver was examined. The observer agreement in the evaluation category "faulty driving behaviour" was very high (correlations of r = .752**and r = .733** for the first and second trip respectively; **p = .000). Similar results were found for the evaluation category "socially tolerated driving behaviour", for which the observer agreement was also high (correlations of r = .432** and r = .517**). The correlations between the observer ratings in the category "particularly careful driving behaviour" were lower, which is probably due to the fact that this behaviour was rarely registered.

Evaluation scheme using the example of driving task 1.1 for the aspect „traffic monitoring“

Figure 2

Driving task	Traffic monitoring	Communication, Distance, Vehicle position	Speed adjustment	
1 Enter traffic, merge, leave a traffic stream, change lanes, pass, overtake	**Particularly careful driving behavior:** detecting unexpected or dangerous driving manoeuvres of other road users and reacting safely to them			Evaluation
	Socially tolerated driving behavior: not selecting a large gap (depending on visibility, road conditions and differential speeds), passing hesitantly			Evaluation
	Faulty driving behavior: lack of traffic observation (e.g. insufficient observation of pedestrians or cyclists, poor observation of lateral or rear traffic, no shoulder check)			Evaluation
2 Driving route				Evaluation
3 Intersection, junction, roundabout, rail traffic				Overall evaluation
4 Pedestrian crossing, bus or tram stop				
	Evaluation	Evaluation	Evaluation	

Approach for giving feedback

The aim of giving feedback is to stimulate self-reflection and behavioural change. Since the target group consists of drivers with a valid driver's licence and several years of driving experience, feedback takes place at eye level. The feedback intervention is not a test, but rather a coaching. The feedback approach consists of three sections that build on each other:

1. self-assessment
2. feedback with evaluation of the trip
3. intention formation

First, the senior drivers are asked to assess the journey and their own driving behaviour. The participant reflects on where it went well/unproblematically and where he or she experienced critical challenges. Second, the driving protocol is evaluated. The self-assessment of the drivers is referred to at the beginning and then the entries made by the accompanying person during the ride are discussed. The main focus is on positive aspects. Feedback on driving errors should be based on concrete examples from the ride and should be embedded in positive feedback. Third, based on the comments and suggestions of the accompanying person the senior drivers are encouraged to develop intentions to change their future driving behaviour.

Effects of the feedback intervention

Method

Experimental design

The effects of the feedback intervention were tested using a randomized control group design with block formation (R(B)) with three groups and two measurements (Table 1). Two experimental groups and one control group were included, each undertaking two drives. The first experimental group received feedback at the end of the first ride, a so-called summative feedback (EG_{summ}). The second experimental group received feedback at the end of the first ride as well as during the ride, a so-called contingent feedback (EG_{cont}). The control group only received short feedback on driving competence after completing the second ride.

Experimental design

Table 1

	Group	Ride 1 (intervention)	Ride 2 (post measurement)
R(B)	EG_{summ}	$X_{1\ feedback\ summ}$	$Y_{1,P}$
	EG	$X_{2\ feedback\ cont}$	$Y_{2,P}$
	CG	$X_{0\ no\ feedback}$	$Y_{0,P}$

In order to avoid distortions of the results due to differences in driving performance, age and sex of the participants, drivers were allocated to the groups as follows. The first third of the participants was randomly assigned to one of the three groups (EG_{summ}, EG_{cont}, CG). Then "triplets" were formed and for each participant already assigned to a group two persons similar in gender, age and mileage were searched for and each assigned to one of the other two groups. This ensured that the three groups did not differ in gender, age and mileage.

Both experimental groups and the control group drove the same route on the first trip and again three months later on the second trip. The route was compiled on the basis of a literature review as well as experience from previous driving trials. The route contained a large number of potentially critical driving situations relevant for senior drivers. The average driving time was 42 minutes (ride 1) and 40 minutes (ride 2) with an average deviation of four minutes and two minutes, respectively. In order to ensure a high degree of closeness to everyday life, the senior drivers used their private cars. The drives were carried out on weekdays and outside of rush hours. All rides were accompanied by an officially recognised expert or examiner (aaSoP) and a psychologist. Both accompanying observers were trained in dealing with senior drivers and in using the Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA).

Sample

A total of N = 135 participants took part in the study (Table 3). The experimental group EG_{summ} consisted of n = 46, the experimental group EGcont of n = 45 and the control group of n = 44 persons. In all three groups:

- 77 percent of the drivers were male
- the average age was 77 years
- the youngest participant was 70 years old and the oldest participant was between 89 and 91 years old
- slightly less than half of the participants stated to drive up to 10,000 kilometres per year, about a third stated to drive more than 10,000 kilometres per year and just under a fifth stated to drive up to 5,000 kilometres per year
- the majority of the participants has had their driver's license for more than 50 years
- about a third of the participants stated that they had previously been professional drivers or frequent drivers

Data collection

During both rides the driving behaviour was recorded using the tablet tool ERIKA. In addition to social and driving demographics, the observers assessed the psychophysical, cognitive and motor performance of the senior drivers. Furthermore, the self-assessment of own driving competence by the participant as well as a global assessment of driving behaviour by the observers were noted.

Results

Does the feedback intervention improve the driving competence of senior drivers?

Table 2 shows the number of behaviours observed for each of the three evaluation categories during ride 1. This corresponds to the status quo of the driving competence of the participants. The two experimental groups are combined in this table. The differences between the control group and the experimental group are not statistically significant. This means that both groups show similar driving behaviour during ride 1. Table 2 also shows that the number of observations per evaluation category varies considerably. While "particularly careful driving behaviour" was very rarely recorded, "socially tolerated driving behaviour" and "faulty driving behaviour" were noted more frequently. For example, the psychologist registered "particularly careful driving behaviour" a total of 12 times, while she noted "socially tolerated driving behaviour" 353 times and "faulty driving behaviour" 506 times in the entire control group.

Furthermore, Table 2 shows the average number of observations per driver. For example, the psychologist registered "particularly careful driving behaviour" 0.27 times, "socially tolerated driving behaviour" 8.02 times and "faulty driving behaviour" 11.5 times per person of the control group.

There were differences between the accompanying observers in the absolute number of observations recorded. The psychologist consistently noted more observations than the examiner did in all evaluation categories. The high observer agreement (cf. Chapter Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA 2019)) shows, however, that there are only quantitative differences in the detail of the recording. At the same time, it also points out the possible room for interpretation when assessing driving competence and the need for structured and standardised observation.

Results of ride 1 per evaluation category and per accompanying observer

Table 2

	Psychologist		Examiner	
Driving behavior	**CG**	**EG (total)**	**CG**	**EG (total)**
Number of observations				
PCDB	12	23	9	19
STDB	353	699	335	563
FDB	506	1,025	241	478
Number of observations per driver (mean)				
PCDB	0.27	0.25	0.20	0.21
STDB	8.02	7.68	7.61	6.19
FDB	11.50	11.26	5.48	5.25

PCDB: particularly careful driving behaviour; STDB: socially tolerated driving behaviour; FDB: faulty driving behavior

Table 3 shows the difference in the evaluation of ride 1 and 2. Here, like before, the two experimental groups were combined. Both the psychologist and the examiner registered significantly less "faulty driving behaviour" for the drivers of the experimental group during ride 2 compared to ride 1. On the contrary, for the driver of the control group "faulty driving behaviour" was counted similarly frequently (examiner) or even more frequently (psychologist) during ride 2 compared to ride 1. This means that participants who had received feedback on their driving competence during or after ride 1 improved in ride 2. This was not the case for participants in the control group who had not received any feedback.

Figure 3 illustrates this interaction. It shows the average number of "faulty driving behaviour" per person during ride 1 and 2. Thus, the reduction of driving errors can be attributed to the effect of the feedback. The feedback intervention tested here can therefore contribute to reducing faulty driving behaviour.

With respect to "socially tolerated driving behaviour" there were no clear results. The changes with regard to "particularly careful driving behaviour" are not meaningful due to the small number of registrations.

Difference between ride 1 and 2*

Table 3

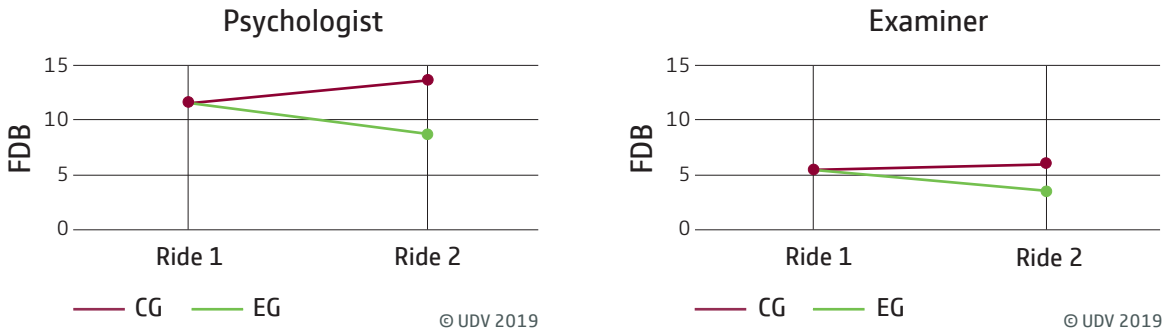
	Psychologist		Examiner	
Driving behavior	CG	EG	CG	EG
PCDB	-0.12	-0.15	-0.13	-0.13
STDB	-1.82	-2.51	-1.87	-1.88
FDB	+2.22	**-2.71****	+0.45	**-1.84****

*Difference per evaluation category per accompanying observer represented by number of observations per driver (mean), (-) decrease, (+) increase

**p < .01

Number of „faulty driving behaviour“

Figure 3



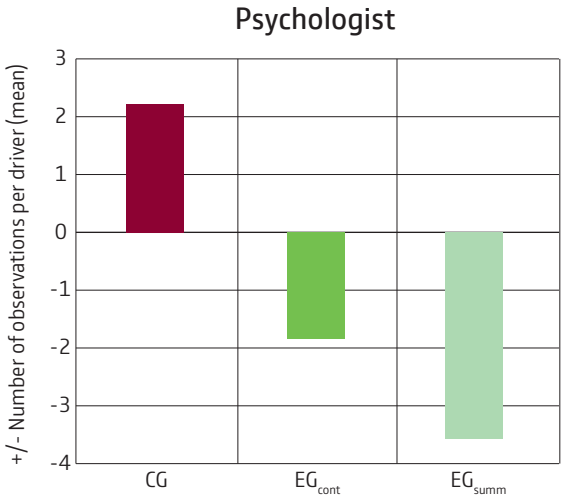
*per driver per group during ride 1 and 2 shown separately for both accompanying observers

Which kind of feedback is most effective?

So far the results indicate a significant effectiveness of the feedback intervention. However, the comparison of the two types of feedback did not yield clear results. It can be assumed that feedback which takes place during the ride (EG_{cont}) is more effective because it is prompt to behavior. However, in the most important evaluation category, "faulty driving behaviour", there seems to be an advantage of feedback after the ride (EG_{summ}) (cf. Figure 4). The registrations made by the psychologist show a statistically significant reduction in driving errors for both types of feedback (EG_{summ} and EG_{cont}) compared to the control group. However, the reduction is stronger if the feedback is given after the ride (EG_{summ}). The observations of the examiner show a similar picture. However, here only the difference between the control group and the EG_{summ} was statistically significant.

Differences between ride 1 and 2 in the number of observations in the evaluation category "faulty driving behavior" per driver*

Figure 4



*shown separately for each group and for both accompanying observers

This also corresponds to the experiences made by the accompanying observers. Especially in complex traffic situations (e.g., intersections, priority rules), the drivers were busy coping with the situation and could hardly receive the feedback. Discussing a complex situation while driving therefore proved to be not feasible. On the other hand, feedback on simple issues (e.g., speeding offences) could be given very well during the ride. Here the accompanying observers assumed that continuous feedback during the ride left a stronger impression than feedback afterwards, especially if a particular situation occurred more frequently.

Overall, feedback after the ride combined with individual elements during the ride seems to be an advisable soluation.

Are there individual differences with respect to the effects of the feedback?

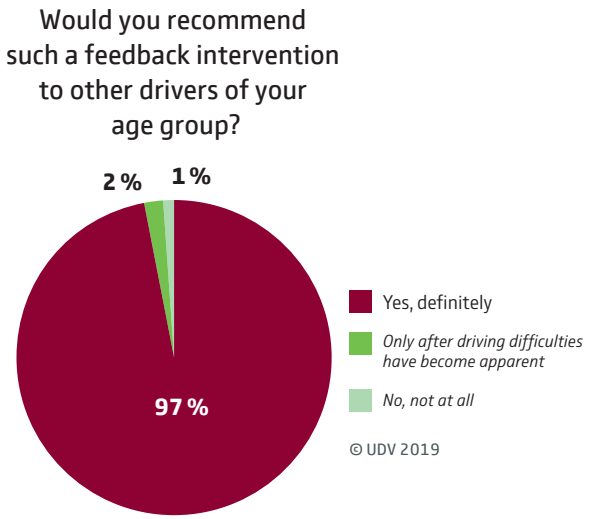
In addition to driving competence, the accompanying observers rated the psychophysical, cognitive and motor performance of the participants. Furthermore, self-assessment of driving competence by the driver him- or herself as well as a global assessment of driving behaviour by the observers were gathered. It was examined whether the feedback intervention has differential effects depending on different manifestations of these aspects. However, there were no indications of this.

How is the acceptance of the feedback intervention?

The feedback intervention was well accepted by the senior drivers. More than 96 percent of the participants were very satisfied with the organisation, the ride and the accompanying observers. The same applied to the satisfaction with the feedback talk. Furthermore, 97 percent of the participants stated that they would recommend the feedback intervention to other drivers of their age group (Figure 5).

Recommendation of the feedback intervention by participating drivers

Figure 5



The guiding principle, "Feedback should not only be deficit-oriented, but also point out strengths and competencies", worked very well. The naming of positive observations was almost demanded by many drivers. With some participants confrontational feedback as "icebreaker" worked quite well to stimulate self-critical reflection. This shows that feedback must be adapted to different degrees of willingness of participants to critically self-reflect. In addition to oral feedback, many participants would like a written competence profile containing a classification within their own age group.

Summary and recommendations

Due to changing demographics and the increasing number of female **holders of drivers licenses**, the number of drivers 75 years and older will roughly double within the next 20 years. Even today, senior drivers themselves cause three quarters of all accidents in which they are involved. The reasons are (non pathological) changes in physical and mental performance, which can (often in interaction with insidious illnesses) have an effect on driving skills. The ageing process, therefore, requires elderly persons to make strong adaptations when driving.

In this study, a measure was developed and evaluated to provide qualified feedback on the driving competence of senior car drivers. The measure consists of an accompanied ride in real traffic, in which driving behaviour is systematically observed and evaluated. At the end feedback is given on the basis of these observations and proposals are provided for maintaining and improving driving competence. For this purpose, an Electronic Feedback Instrument on Senior Drivers' Competencies (ERIKA) was developed and successfully applied. The revised version (ERIKA 2019) is available as a specification book for electronic implementation.

The effectiveness of the feedback intervention for influencing the driving competence of senior drivers was tested with a total of 135 participants. All participants drove the same route on the first trip and three months later again on the second trip. Participants who had received feedback on their driving competence during or after the first trip showed significantly less faulty driving behaviour on the second trip. This was not the case for participants who had not received any feedback. A feedback intervention is therefore basically suited as a low-threshold offer to maintain and improve driving skills in old age.

It is important that this feedback is not misinterpreted in the sense of another driving test. The aim is to show senior drivers at eye level how they can maintain safe car mobility. Comprehensive training of the experts who accompany the ride as observers is essential for this.

The instrument of feedback intervention should in the first place be offered voluntarily and optimised in practice. If, however, it turns out that the target group is not sufficiently reached in this way, mandatory participation can also be considered.

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