REFRESHER COURSES FOR OLDER DRIVERS – A LITERATURE STUDY

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Summary

This paper is based on a literature survey on refresher courses for older drivers, which was conducted in a project commissioned by the Norwegian Road Administration. The aim was to determine if there is any scientific evidence that refresher courses are an effective intervention for older drivers in terms of sustained safe mobility. The current literature study covering the period 1999 to 2009 provides some evidence that refresher courses can be an effective means to promote both mobility and safety for older drivers. Most studies were conducted in the US and Canada. Courses were grouped in to general and traffic specific education (theoretical) and training (practical). General education can include e.g. knowledge about aging and performance while general training can be e.g. cognitive training programs. Traffic specific education includes e.g. knowledge of new traffic rules while traffic specific training can be closed track driving with an instructor. Most courses were theoretical and consisted of a mix of general knowledge on aging and traffic specific knowledge on handling critical situations and often promoting a cautious driving style. A wide range of methods were used ranging from traditional classroom teaching to coaching by driving instructors. Simulator based training was seldom used even if a general interest is often expressed by participants. Both learning theories and evaluation methods should be further developed, not the least with respect recent neuropsychological research on aging and cognition. Even if there seems to be evidence that refresher courses can be effective there are also findings indicating significant problems; some older drivers seem to be quite reluctant to change their behaviour which can be due to lack of self-awareness or personality. Furthermore, older drivers are often heterogeneous in terms of needs and abilities. Thus, there is a need adapt course content and methods to better conform to individual needs and target certain groups of older drivers, e.g. over and under estimators. Finally, it sometimes seems difficult to reach those with the greatest need for training e.g. persons who have not been driving for a long time and suddenly are forced to due to family changes.

1. Background

The aging part of the population is rapidly growing all over the world. Thus, there will be more older drivers on the roads. Age related changes can be a threat to traffic safety even if it not as easy as to say that older drivers constitute a traffic safety problem per se. Furthermore, as we get older we get more fragile and vulnerable and the consequences of a crash are likey to be more severe. At the same time, independent mobility will promote sustained health and well-being. Experience increase with age and exposure, at the same time the number of new situations that we potentially can learn from seem to decrease. Thus, it is easy to think there is nothing new to learn and to rely too much on routine. However, a safe driver has been called a learning driver. That is a safe driver is a driver who always is willing to assimilate new experiences with the aim to further develop knowledge and skills. When we refrain from leaning, safety is at stake. At the same time, performance degrade with age, traffic gets more complex and demanding, vehicles get more sophisticated with new functions etc. Such changes can make older drivers unknowingly or knowingly adopt a more defensive driving style to maintain a feeling of safety. Defensive driving, frequently recommended for older drivers, can have both pros and cons. Positive might be avoiding potentially dangerous situations, on the other hand it can make drivers less prepared to handle a critical situation

should it occur. Both over and underestimation of own skills can jeopardize a safe independent mobility.

Refresher courses for older drivers can be one possible way to promote safe mobility to the aging population. However, there are many questions related to such an intervention. Is the target population susceptible to learning? What should the learning objectives be? How should courses be designed? What methods should be used? Will courses actually improve safety and mobility? Remember the old saying “You can't teach an old dog new tricks”. The good news is that recent research seem to show that the cognitive prerequisites to train new skills among older is much better than previously thought. For example, there seems to be some evidence that stroke patients (older) can improve their working memory through specific training programs [Kramer et al., 2008; Westerberg et al., 2007]. Thus, it seems like it might be possible to tech old dog “new tricks” even after a stroke. Even so, there is good reason to reflect on learning objectives and methods. Peters et al [2010) argue that course curricula should be based on a theoretical framework as the GDE (Goals for Driver Education) Hatakka et al. [2002]. Considering education and training methods, the CLT (Cognitive Load Theory) which has been successfully used on young but also proven successful in practice with older persons [van Gerven et al., 2002]. Self-awareness and risk assessment (highlighted in the GDE framework) demand some feeling of your own performance limit. A safe driver should have a reasonable understanding of the margins. Weinberg and Weinberg [1979] put it as one must sometimes temporarily lose control in order to maintain control ("the fundamental regulator paradox"). That means exercises where a driver can lose control without risk of serious consequences may be important for maintaining a safe driving behaviour. Such training could be implemented in a driving simulator. Furthermore, objectives, content, teaching and evaluation methods should be better aligned and based on older drivers’ needs and abilities. This is in line with the ideas of Problem Based Learning (PBL) and constructive alignment [Biggs, 2003]. Finally, course evaluation and feedback is a critical to a successful educational intervention.

Here are two practical examples of success which gives further hope. Bolin [2009] conducted an interesting study in which a group of 31 active drivers (older than 70 years) used to drive with manual gearshift, drove a predetermined route with manual gearshift and automatic transmission. A frequent recommendation given to older driver is that if you are used to drive with a manual gearshift stick to that – it is too difficult to learn something new. However, it was found that automatic transmission had a significant positive effect on driving behaviour. Speed adjustment, attention, distraction coping and behaviour in intersections all improved. Pollatsek et al. [2012] performed a study on older drivers with focus on visual scanning behaviour at intersections, a situation in which older drivers are more involved in accidents compared to other drivers. Based on the finding that older driver seems to attend less to critical regions they developed a training program to improve scanning behaviour. They found that incorrect scanning behaviour rather than deteriorating physical or mental capabilities and thus that training may be effective in reducing crashes. Thus, there seems like refresher courses have a potential to improve safety and subsequently mobility for older drivers. This was the background for the current literature survey. How far have we come?

2. Method

Three different bibliographical databases were used to identify relevant articles: TRIS, ITRD and TRAX. More than 80 articles were initially found but only 20 were considered relevant. The courses were categorized according to the content and form. Thus, a distinction was made between theoretical education and practical training. Furthermore, education and training was divided into general and traffic specific. Sometimes theoretical and practical training is combined. The following grouping was used:

1. General theoretical education (not traffic specific)
    a. Knowledge about age related functional degradation
    b. Knowledge about abilities possible to train and how to do it

2. General practical training (not traffic specific)
    a. Physical training (mobility, strength, reaction)
    b. Perceptual training (visual attention)
    c. Cognitive training (memory, executive functions)
3. Theoretical education (traffic specific)
    a. Classroom teaching, study circle, group discussions
    b. Tutorials (traditional and web based)
4. Practical training (traffic specific)
    a. Training with instructor in real traffic
    b. Training on closed track with instructor
    c. Driving simulator based training with and without instructor

3. Results

Most articles reviewed concerned evaluations of refresher courses in the USA, Canada and Australia. Very little was found about the situation in Europe. Furthermore, theoretical aspects of aging and leaning/training were seldom considered in the literature found.

3.1 Previous reviews

A chapter in Levin et al. [2007] includes a review and discusses the pros and cons with refresher courses for older drivers. Most courses given are theoretical aiming to improve knowledge. Practical training is seldom included, specifically simulator based training is virtually never used. Handbooks and checklists concerned with aging and driving are used in several countries. Very few studies have been carried out with objective to assess safety and mobility effects. Even if there is a potential in driver training for older driver there are gaps and unanswered questions e.g.: How should an effective education and training be designed? How can the effectiveness be assessed?

Kua et al. [2007] conducted a critical review of 103 articles in order to find evidence that driver training for the elderly is an effective intervention. The studies were grouped according to what had been trained: physical retraining, visual perception, or education. They classified the studies according "Physiotherapy Evidence Database (PEDro) Scale". This scale was used to qualitatively classify articles with regard to e.g. internal validity, randomization of conditions, control condition and adequacy of follow up. The articles were then classified as excellent, good, acceptable and unacceptable. The authors found that only 8 articles eight met the inclusion criteria ("good" or above) of these were 6 studies of the type "case-control" (specifically, RCT-Randomized Control Trials), one "dose-response" and one a descriptive study. The following interventions were represented: physical training (1), visual perception (1), education (5), a combination of the three preceding (1). They found some evidence that physical training and visual perception improve driving related skills in older drivers. Furthermore, they found moderate evidence that education can improve driving awareness and behaviour positively, but the intervention does not appear to reduce the number of crashes. The authors argued that there is limited but sufficient evidence the effectiveness of retraining aimed at older drivers is effective to merit further research even if it is unclear whether it leads to a reduction in the number of accidents.

Korner-Bitensky et al. [2009] reviewed four articles and found good evidence that education and driver training improves driving skills, and moderate evidence that it leads to improved knowledge. Furthermore, the authors found moderate evidence that physical exercise improves the driving skills and classroom teaching can reduce the number of accidents.

3.2 General theoretical education (not traffic specific)

No articles were found that only concerned general theoretical education on aging without specific focus on traffic but of relevance to driving. Effects of aging is mainly addressed in relation to driving.

3.3 General practical training (not traffic specific)

Four articles addressed general practical training.

3.3.1 Physical training

Marottoli et al. [2007] conducted a RCT study where a group of 178 senior (70 years and older) drivers with physical disabilities, primarily in neck and shoulders, but otherwise healthy participated. Inclusion criteria were: no degenerative disease, binocular acuity of at least 20/40 and MMT/MMSE (Mini-Mental State Examination) scores greater than or equal to 24 (max 30). The experimental group were offered a physical training (mobility, coordination and speed) while the control group received theoretical education in safety. Both groups made a pre and post (3 months after) on-road driving test with focus on safety. Driving performance was assessed by an experienced evaluator (occupational therapist). Performance was rated in three ways:

- A 36-item scale evaluating driving manoeuvres and traffic situations
- Evaluator's overall rating
- Critical errors committed

Those who had undergone the training performed better at the driving test than the control group three months after training. They also made fewer errors than the control group but there was no difference in the overall assessment.

3.3.2 Perceptual training

Regarding perceptual training, efforts have primarily focused on visual behaviour (scanning and reaction). The following study evaluated the training impact on response time ("speed-of-processing") which can be seen as a visual/cognitive ability but have been placed under the heading of perceptual training as Useful Field of View (UFOV) has a central role. Roenker et al. [2003] conducted a RCT study in which they examined the effect of a general reaction training (speed-of-processing) and compared both with simple driving training (theory and video) and a control condition (base-line) without any training. The purpose was to find out which training method (general or specific) gave the best effect on older drivers with visual deficiencies. More than 450 elderly were examined with regard to visual performance e.g. UFOV. The UFOV results were used to group subjects into different conditions. A visual reduction of less than 30% was considered as low risk and over as an indication that there was a need for improvement. Thus a group of 25 drivers with low risk were randomly selected as a control group. Then they recruited approximately 75 drivers with training needs considering that 2/3 should undergo general reaction time training and 1/3 specific driving training. Ninety-five people completed the full study, including 25 in the control group, while 48 did the speed-of-processing training and 22 received simulator training. Reaction time training was tailored individually based on their UFOV data. The simulator group received both a theoretical training on how to deal with dangerous situations and learn from video sequences how to avoid dangerous situations. An evaluation (driving on the road and in the simulator) was made before, immediately after the training was completed and 18 months later. Reaction time training resulted in better UFOV-achievements, in some respects, the participants performed better in the simulator and made fewer dangerous manoeuvres on the road. The group that had specific driving training became better at lane change behaviour and use of direction indicators. This change did not occur in either the control group or the speed-of-processing group. Follow-up after 18 months showed that the improvements persisted for the speed-of-processing time group but not for the simulator group. In conclusion the authors means that practical training (hands on) provides better results than theoretical but also that specific training as the simulator group received improves what was specifically trained (e.g. manoeuvring) while more generic training (i.e. speed-of-processing) provides more persistent improvements.

Edwards et al. [2009] conducted a similar RCT study as Roenker et al. [2003], but this study focused on mobility. Also this time the focus was on elderly persons with low scores on an initial UFOV test (indicating an increased risk of at fault crashes). The low scorers were

divided into two groups; one speed-of-processing training group and one social and computer contact control group. Furthermore, there was a control group who did not score poorly on the initial UFOV test. The evaluation continued for three years. It turned out that those who performed the speed-of-processing training were able to maintain their mobility to a greater extent and their mobility differed not from the control group without visual disabilities. On the other hand, the mobility of social and computer contact group decreased. The authors believe that the training of "speed-of-processing" not only leads to better driving performance but also manifests itself in maintained mobility.

3.3.3 Cognitive training

Cassavaugh and Kramer [2009] carried out an interesting and unique study which examined the possibilities to train abilities such as attention, memory, and motor control using computer based training and evaluated the effects in a driving simulator with regard to driving performance (lateral and longitudinal control, attention, and memory). The training was conducted in 8 steps. Training was preceded by a driving performance assessment in a simulator (baseline) that was repeated after the entire training. A computer-based training program (PC with Logitech MOMO control) was used, which consisted of four different training tasks (simple and combined):

1. Tracking task
2. Visual selective attention task (similar to UFOV)
3. Visual–spatial N-back task (working memory task)
4. Dual task (tracking task combined with 2 or 3)

The target group was voluntary active older drivers (average age: 77 years) without cognitive impairments. The evaluation was made in the form of a driving test in a simulator which included specific situations that were used for the evaluation. The situations were

1. follow a car which varied the speed and keep constant distance
2. visual memory, remember colours of cars passing
3. detection of an object (road barriers) that was 20% transparent
4. combinations of 1 + 2 and 1 + 3.

The aim was also to examine whether a) result from the initial driving test, b) initial results of the training session or c) training effect could predict the outcome of the final driving test. The results showed that some improvement in driving performance could be predicted based on the training results for both simple and combined training tasks. The authors believe the results show that relatively simple cognitive training for a limited period of time can have positive effects on driving performance. This article is also interesting because it takes up a little on the theories behind the design of the training be evaluated.

3.4 Theoretical education (traffic specific)

Two courses for older drivers, AAA Safe Driving for Mature Operators and the AARP Driver Safety Program are regularly run in the US. Both courses are basically theoretical, but can be supplemented by practical exercises. The course length is between 4 and 8 hours. AARP Driver Safety Program seems to be assessed regularly. The course has been given since 1979 and more than 10 million Americans have participated until 2008.

3.4.1 Classroom teaching, study circle, group discussions

Tuokko [2007] conducted a questionnaire study among prospective participants in a course for older drivers. It is unfortunately not entirely clear which type of course it was, but probably it was a conventional theoretical course. The target audience was older motorists in Victoria, Canada. A questionnaire addressed to 86 prospective course participants (most women) who raised the following areas: risk perception (locus of control, expectation of crash, vulnerability), opinions and attitudes, openness to change. It turned out that the participants were not particularly concerned about their own driving performance, but more interested in maintaining their mobility. There were also some gender differences. Men were more

reluctant to change their driving behaviour, males drove more often after drinking alcohol, and females meant that driving cessation was more a family decision compared to males.

AARP [AARP, 2004] conducted a review of its course AARP Driver Safety program. The course was as an instructor-led classroom training (4 – 8 hours). The main topic taught was the effects of aging on driving and strategies to adapt to the changes. The aim was to change the participants driving behaviour and to consider whether to continue to drive or give it up. The parget participants were drivers aged over 50 years. They evaluated the course both from the course organisers (instructors, coordinators and trainers) and course participants' perspective. A postal questionnaire was sent to 10,000 organisers and 10,000 course participants. The response rate was 32% respectively 35%. Feedback was received on course moments that were considered good, what could be done better and what was missing from both instructors' and participants ' perspective. A Web-based course was requested. 92% of the participants indicated that they had at least changed on one driving behaviour aspect. The most common behavioural change was experienced improvements with regards to blind spots attention, keeping distance to other vehicles, improved attention at motorway ramps and to give way. Furthermore, it was found that 63% believed that the course had helped them to avoid accidents.

Some years later, Skufca [2008a] undertook a re-evaluation of the same course (AARP Driver Safety program). 10,000 randomly selected course participants (May – August 2007) responded a postal questionnaire. Response rate was 53%. It turned out that 95% of the participants had changed some important driving behaviour and, on average, five different behaviours were altered. The three most common changes were; to check blind spots, keep distance to lead vehicles and to scanning traffic. The least reported the change was to "limit driving or stop driving." The results also showed that drivers aged over 75 years changed more compared to younger. They also thought that the course had contributed to avoiding accidents more frequently than the younger participants. Women reported improved driving performance over the last five years, more frequently than men. High satisfaction among participants was also reported. Skufca did two more evaluations of AARP course [Skufca, 2008b (August to September 2007) and Skufca, 2008c (May – August 2008)] with similar results as above.

Nasvadi and Vavrik [2007] conducted an interesting and as it seems a quite unique evaluation of "55 Alive Mature Driving program/"in Canada (similar to the AARP Driver Safety program). The following subjects were included in the course: overview, self-assessment, vision/hearing, normal driving, dangerous situations, driver support, vehicle, alcohol and medicine, and decision-making. The target group for this course were persons over 50 (average age of participants was 75 years). The study purpose was to investigate whether retraining of older drivers could help to reduce accident involvement. Thus, participants' accident records before and after the course were analysed. They used a model from Baltes and Baltes [1990] referred to as SOC (selection, optimization, compensation). The authors wanted to investigate if there were certain categories of drivers who attended the course, whether it was to distinguish different types of participants with respect to accident involvement before the course and to investigate possible effect on accident involvement. The first step was to find matched groups who had gone and had not passed the course. A group of 884 drivers was identified as course attendees and a matched (age, gender, and postal code) control group was formed. An individually matched control group was randomly selected among those who matched the criteria. The two groups were then compared in terms of accident involvement before and after the course. Finally, three focus groups were conducted. The first group included drivers who had not been involved in any accidents before, nor after the course ("perfect"), the second consisted of drivers who had crashed before but not after ("pre-crashers"), while the third group included drivers who had crashed both before and after the course ("crashers"). It was found that course attendees had been involved in more accidents before compared to the control group. This was specifically prominent among the oldest drivers. Furthermore, the authors found that the course had no

effect on accident involvement in general. However, the course appeared to have an adverse effect on older male drivers but not on females. It was also found that "crashers" were quite resistant to education interventions and they meant that it was other drivers who did not behave correctly. Furthermore, the “crashers” did not remember as many details from the course as did the other participants. The focus groups showed that older male drivers had more difficult to tackle failing skill. The conclusions the authors drew was that it is important to know which ones are participating in courses and that the courses are designed according to the participants ' needs. Finally, the authors were fairly sceptical about the value of this type of courses for older drivers.

Nasvadi [2007] also conducted an evaluation of the same course as above in the form of a telephone interview among 367 participants. The respondents were between 55 and 94 years. It turned out that 20% of the participants were persuaded by their spouses or partners to participate, specifically males had been convinced by their wives. What the participants best remembered from the course was the necessity of attention, traffic rules and road signs, visual perception, self-knowledge, manoeuvrability, speed and safety margins. Furthermore, it was found that 75% said that they had changed their driving style after the course in terms of increased attention, visual scanning, change of attitude, speed adaptation and spatial position etc. (compare with {AARP, 2004& Skufca, 2008a,b,c]). The men, especially the older said that their driving style had improved. Finally, the investigation showed the need to adapt the course so that all feel safe to express their views and the participants also asked for more practical training.

Bédard et al. [2004] conducted a RCT-study which evaluated the “55 Alive Mature Driving Program” in Canada. The course was aimed at active healthy drivers over 50 years in the Ontario area and consisted of 6 hours of theory. The participants were active elderly drivers without cognitive disabilities (MMSE > 24). Participants (65 people) conducted a preliminary driving test on the road and were then divided randomly into two groups; one that took the course directly, and one who had to wait (control). Driving test took about 35 minutes. The course was conducted within two months. All participants then made the driving test again. Despite an improvement no differences were detected between those who took the course and the control group. Those who performed the worst first improved their performance more than those who performed well in the beginning. Age correlated negatively with the achievement but not with respect to the change. The control group were offered to attend the course after the second driving test. The authors believe that the loss of effect of education could be due to several factors: feedback at the first driving test (to all), test effect, knowledge transfer between participants (all lived in the same area), etc. The authors were nevertheless in favour of the education of older drivers and give a variety of proposals for further studies.

A course called “Wiser Driving Course” is given in Australia. It is a discussion based course lasting four weeks with one meeting per week. Focus is on safety and mobility. The course consists of only theoretical education and the aim is to change driving behaviour. Topics covered are vehicles, health and eyesight, traffic rules, driving behaviour, alternative means of transport, accidents and violations. Strain [2003] made an evaluation of the course during the period 2001-2002. The participants were between 60 and 85 years with a majority of 75-79 years old attendees. One-third was men and two-thirds were women. The evaluation was carried out as a before/after study (questionnaire) to 183 participants from 20 courses. A follow-up was also conducted as a self-rated assessment of changes, three months after the course. It turned out that 63% of the participants had acquired 1 to 4 pre-specified changes in driving behaviour. In addition, 80% said that they, in one way or another, had adopted a different driving style. The author means that the course had measurable positive effects in terms of self-assessed changes in driving behaviour.

Norway has a long tradition of refresher courses for older drivers. Since 1991, a course called “Bilfører 65 +” is offered to all Norwegian driving license holders over 65 (now 70 years). It is a traditional theoretical course with aiming to maintaining older people's mobility

and reducing their risk of accidents on the road. This voluntary refresher course is supervised by the national road administration (Statens Vegvesen). Ulleberg [2006] conducted an evaluation of the “Bilfører 65 +” course. The results showed that older people's mobility and perceived safety did not change upon completion of the course. On the other hand, the study indicates that the risk of being involved in a traffic accident is tentatively reduced after the training.

3.4.2 Tutorials (traditional and web-based)

Tutorials can have certain advantages: they can be carried out self- pace and at times that suit the individual. A further advantage is that insecure attendees who do not want to expose their uncertainty can dare for more but, on the other hand, would remove much of the benefits of group discussions and exchange of peer experience. Previous evaluations of the AARP Driver Safety Program revealed a demand for Web-based courses. Skufca [2008b] did an evaluation of an on-line version (web-based) version of the AARP Driver Safety Program. This version of the course allows attendees to follow the course at their own pace. The course includes effects of aging on driving and strategies for how to adapt to these changes. The goal was to promote changed behaviour. The evaluation was carried out with a Web-based questionnaire to 2,325 randomly selected participants who did the course in the period August -December 2007. Response rate was 47%. It was found that 88% changed some important driving behaviour and, on average, the respondents identified five behavioural changes. Basically the same results were obtained as Skufca [2008c] found for the traditional form but participants reported fewer behavioural changes. Course takers older than 75 years changed more than others. The majority of participants considered that the course had contributed to avoiding accidents. Overall, the participants were very satisfied with the course. It seems that web-based tutorials provides the same results in terms of types of changes but the traditional teaching seems to yield more changes in driving behaviour.

3.5 Practical training (traffic specific)

Standalone practical training for older drivers does not seem to occur very often but one can envisage in principle three different forms of training: in real traffic with instructor, on closed track and driving simulator. There can be multiple objectives for practical hands-on training experience e.g. training to improve driving skills or to improve risk assessment and self-awareness (exposure to critical situations). Training which means that the driver is subjected to critical situations can only be implemented at either closed track training or in a driving simulator. But this is an area that is relatively unexplored with regard to potential effects.

3.5.1 Training with instructor in real traffic

The literature search did not reveal any examples of training in traffic but personal communication with a German colleague [Poschadel, 2009] provided some information on an on-going project. An RCT-project was implemented in order to evaluate whether practical training for older drivers with a driving instructor can lead to lasting improvement of driving skills as measured by the TRIP (Testride for Investigation Practical fitness to drive) protocol. The intention is to carry out a follow-up in 6 and 12 months after the training session. The training consisted of 15 hours of instructor-led training on the road with a focus on particularly difficult situations. The study involved 92 subjects. The gender balance was even and all participants were older than 70 years. The participants were divided into a training group and a control group. Driving ability was measured before and after training. Even if it turned out that all drivers (control and training groups) performed reasonably well, it was found that the training group performed significantly (1%) better than the control group directly after the training. Follow-up after 6 and 12 months is yet to be implemented. The researchers were thus able to see the positive effects of the training session even though they believe that the impact would be even greater if they had focused on drivers who initially performed worse. Information on the costs is missing, but the 15-hour training will be quite expensive and in parity with the cost of a B driving licence.

3.5.2 Training on closed track with instructor

No articles were found on training of older drives on closed tracks. However, Rosenbloom et al. [2008] evaluated the effects of skid training and feedback from driving training. The purpose was to demonstrate the risks of losing control of the vehicle. The participants consisted of two groups, on the other hand, 135 young licence holders and partly 89 "older" (23 – 64 years) experienced drivers. Among the most experienced, there were 44 professional drivers. The evaluation was carried out in the form of a questionnaire on risk assessment (34 situations which were assessed on a 5-point scale (from no risk (1) to very risky (5)) before and after the training. Significant differences were obtained with respect to the before/after, sex and age. Furthermore, it was found that women had a higher estimation of the risk before/after comparison with men and older higher than younger ones. The change remained after two months in an evaluation of a smaller group of participants. Although this study did not focus on older drivers per se the results indicate that exposure to hazardous situations can have a positive effect on risk assessment.

3.5.3 Training driving simulators with or without instructor

The literature search did not reveal any examples of studies that evaluated the effects of driving simulator based training for older drivers but such training is receiving more interest from both participants and course organizer [Peters et al., 2010]. There are both pros and cons with simulator based training but it definitely has a potential that should be explored. To this we need to further develop both theories of learning and relevant evaluation methods.

In a paper by Peters and Nielsen [2007] it was argued that refresher courses for older drivers can benefit from the use of driving simulators as effective training tools. As an example, in a simulator it is possible to expose drivers to critical situations not possible to do on the road in real traffic. Such experiences can be a means to calibrate a driver's perception of personal performance. Both over and under estimators (of own driving skill) can gain from such training if it is designed according to individual needs and resources. This is one objective of a currently on-going collaborative (Sweden – France) project called SafeMove [2012]. Surveys among older (70+ years) drivers (license holders) will be made in both France and Sweden with the objective to identify over and under estimators in terms of perceived driving skills. A subset of these respondents will be offered to participate a in a training course including dedicated (based on identified needs) simulator based training. Also the potential in advanced driver support systems for older drivers will be investigated.

There are several possible explanations for why driving simulators are not used to train older drivers [Levin et al., 2007]. First of all, access to driving simulators and relevant training programs is limited but perhaps a most serious problem is simulator sickness that seems to be much more frequent among older drivers [Henriksson and Peters, 2007]. The reason for this in not fully understood but current knowledge can be used to compile guidelines on how to minimize the problem. This is also a task within the SafeMove project.

3.6 Combination of theoretical education and practical training

Marottoli [2007] conducted an evaluation of *AAA Safe Driving for Mature Operators*. The course was given in the form of classroom (2 * 4 hours) teaching and practical driving (2 hours) which included situations known to be problematic for older drivers. Participants were recruited from among active drivers over 70 years in Connecticut. A total of 126 drivers participated divided in to a test group and a control group. Test group received education and training during 8 weeks and was compared to the control group who received two hours of theoretical training on vehicles, home and safety. A driving test was carried out before and after the course, as well as a written test which was distributed after the course. An experienced assessor made an assessment of driving performance with respect to 36 different factors with a scale of 0 – 2 (maximum score: 72). Maximum score for the written test was 28. The test group improved its driving performance significantly (1%) with 2.87 points and theory skills by 3.45 points more than the control group. The conclusion was that

a combination of classroom education and practical driving training will improve both knowledge and driving skills. This type of intervention was considered to contribute to both improved safety and mobility.

Bédard, Porter et al. [2008] carried out a RCT-study to evaluate a combined theoretical and practical training course. Knowledge and driving skills were measured before and after training. The participants were divided into an experimental (training) group (38 persons) and control (not training) group (37). The average age was 75 years and all were experienced, active drivers. The control group was offered to take the course afterwards. It turned out that the experimental group improved their skills: the proportion of correct responses amounted to 61% before the course and 81% afterwards. A comparison with the control group, however, seems to be missing. The result of the driving test showed that the experimental group had improved their driving skills more than the control group in some respects. Even if the result was positive, the authors believe that further research is needed to elucidate the possible effects of accidents and self-confidence.

4. Discussion

4.1 Education and training for older drivers in general

Because age related health changes appear gradually and insidious and normal driving is usually a self-paced routine task, there is a risk that the awareness of changes is low. Thus, older drivers may be poorly calibrated in terms of their own skills relative the requirements in a critical situation. Thus, an important goal for refresher courses, beyond knowledge and skill training, should be to recalibrate the driver and to improve self-awareness and risk assessment. Self- awareness and risk assessment are key factors in safe driving behaviour. The presumptions today are much better to design effective refresher courses for the aging population. Furthermore, even older drivers can improve their driving skills and develop new strategies to drive safely. However, it seems like course objectives, content, teaching and evaluation methods can be significantly improved and aligned. The challenge is to exploit recent knowledge on aging an leaning!

4.2 General education and training

The literature reviewed contained no studies on general education and training for the older drivers. This can, of course, depend on both the search profile and reviewed databases. However, recent research indicates that older people have better ability to learn new things than was previously believed. Especially if the teaching is adapted to the target group's abilities and needs. As regards to training of various abilities (physical, perceptual and cognitive skills) it seems like general training has positive effects which can improve or at least sustain both safety and mobility. Of special interest is the study described by Cassavaugh & Kramer [2009] – relative simple cognitive training can have positive effects on driving performance. Furthermore, it would be interesting to explore the potential with alternative education methods applying e.g. PBL [Peters et al., 2010] and CLT [van Gerven et al., 2002].

4.3 Traffic specific education and training

The traditional theoretical education of older drivers seems to have positive effects, even if it does not apply to all driver categories (e.g. the "crasher" in Nasvadi and Vavrik [2007]. Furthermore, there seems like courses should be better adapted to individual and/or group requirements. It is often stated that participants want more hands-on training and less theory. Even if it might be a matter of cost it should be tried as a quality improvement possible to bear its own cost. In sparsely populated countries like Sweden and Norway, it might be worth exploring the potential of Web-based courses suitable for self-study. It could be a way to reach country side residents who are more dependent on driving their own car compared to city dwellers. Driving simulators are mentioned from time to time as a potential effective tool for training older drivers not at least in terms of self-awareness and risk assessment but there are some problems related to simulator based training that need to be further

investigated e.g. simulator sickness. However, much of the problems can be reduced with improved training design and enhances technology. It is important to start with a pedagogical approach and not the technology in order to determine what may be appropriate to train in a simulator and how. What is being groomed to be generalized and transferred to real driving; It will not only become a better driver simulator. Personalised on-road driving can certainly have good effects, see [Poschadel, 2009], but it is probably too expensive to realize generally.

5. Conclusions

Refresher courses for older drivers seem to have a good potential to enhance both safety and mobility for an increasing part of the global population even if there is no clear consensus. Crash involvement might not always be a result of declining abilities but rather incorrect behaviour which can be corrected. If courses are adapted to the target group's needs and abilities improved results could be achieved. However, a problem can be to reach those in best need, e.g. “low mileage new widows” living in the country side. New approaches should be tried. Course participant often express a wish for more practical training, and even simulator based training.. Used in the right way simulator based training can be a way to recalibrate both over and under estimators. There are also other possible measures to improve refresher courses for older drivers by e.g. applying more recent pedagogics and also considering more recent neuropsychological and cognitive finding on the learning aging brain. This should be better reflected in design of refresher course. Finally, course alignment and evaluation methods need to be further improved.

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