TOWARDS KEEPING ELDERLY SAFE AND FOR LONGER BEHIND THE STEERING WHEEL

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ABSTRACT

In contrast to the belief of many people, driving is not a luxury for elderly people, it is a necessity and one of the cornerstones of their quality of life. As over 25% of elderly Americans are not able to use public transport and as losing the driving license after several decades of driving may easily lead to immobility and social isolation, it is our obligation to develop the required knowledge, so as to establish national policies for delivering certification of fitness to drive and helping as much as possible older age groups to continue driving safely. Enhanced mobility leads to increased well-being for them.

The present paper focuses on two inter-related aspects of driving ability of the elderly. Initially, the accident statistics of elderly drivers are critically reviewed. Older drivers as a group do not have higher accidents rates than other groups, when the statistics are corrected for yearly mileage. They are over-represented however in specific types of accidents, i.e. left turns, T-junctions, lane changing, etc. In accordance to this, the elderly drivers’ licenses renewal policies of 12 European countries are compared, showing the lack of a clear concept on “who’s accidents are elderly accidents”, meaning how to find these elderly drivers who, due to psychophysiological problems belong to the enhanced risk group, without putting the whole elderly population in an unnecessary ordeal. The current assessment tools limitations are mentioned and the methodology of AGILE project (QLRT-2001-00118) to develop a new set of training, information, counseling and driving ability and support tools for the elderly is being analysed.

INTRODUCTION

In western society the older population is increasing both in absolute and relative terms [Transportation Research Board, 1988]. These demographic trends alone will lead to a greater participation of older persons in traffic. In addition, future cohorts of older people will be different traffic participants from today’s: in many European countries and in Japan [Hakamies-Blomqvist, 1996], mass motorization only developed in the 1960s, generally each family having a car, usually driven by the man alone. Also, because of the generally smaller distances and the availability of alternative means of transportation, the car was not as necessary as it was in America or Australia. Therefore, many older Europeans and Japanese, particularly women, do not yet possess a driving license. For example, in the Netherlands 65% of older men, and only 21% of women aged 65 years and older, held a driving license in 1990 [CBS, 1992]. The trend is that numbers of older drivers will become much greater (Finland report a percentage growth of 89% for male elderly drivers and 269,3% for female
elderly drivers between the years 1970 and 1990 [Hakamies-Blomqvist, 1996]) with numbers more evenly distributed between the sexes. The mean number of elderly drivers on European roads can therefore be approximated to around 12% of all drivers today and around 20% by year 2010 [EDDIT1994].

The importance of driving for elderly people is not self-evident and may be perceived, only when comparing it to the other modes of transportation. Driving is a user friendly transport mode for elderly people, as shown in Table 1. Many of them are not able to walk the required distance, stand for a long time or have the overall physical endurance to use public transportation means (over 25% of elderly Americans are not able to use public transport [Waller and Goo, 1969]). Thus, enabling older people to drive has practical, social and personal value with significant implications for their quality of life through sustaining their independent mobility. As manifested by the American Association of Retired Persons, “For the average older driver, losing a license is like breaking a hip and having to go into a nursing home: Suddenly you are immobile, you can’t go anywhere. Even if you limit yourself to sunny days and certain hours, you want that independence”.

<table>
<thead>
<tr>
<th>Private car</th>
<th>Public transport</th>
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<tr>
<td>Luggage transportation easy</td>
<td>Luggage transportation difficult</td>
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<tr>
<td>High psychosocial safety</td>
<td>Low psychosocial safety</td>
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<tr>
<td>Much privacy</td>
<td>Little privacy</td>
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<tr>
<td>Seat assured</td>
<td>Seat uncertain</td>
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<tr>
<td>Parking necessary</td>
<td>No parking problems</td>
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<tr>
<td>Weather protection good</td>
<td>Cold and windy stations</td>
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<tr>
<td>Walking distance &lt;400 m</td>
<td>Walking distance &gt;400 m</td>
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<tr>
<td>Entrance easy</td>
<td>Entrance difficult</td>
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<td>Moderate casualty risk</td>
<td>Low casualty risk</td>
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Table 1: Comfort features of the private car and traditional public transport. In the case where a particular mode of transportation has an advantage over the other for older persons, taking into account the average physical capabilities of people over 65, the desired feature is italicised [Brouwer and Ponds, 1994].

One of the new scientific challenges will thus concern the older car driver. Car driving is a very complex cognitive activity, even if many of its aspects are automated. Since, during the normal ageing process several cognitive functions may decline, it is very important to identify those that are related to driving. In addition to the normal cognitive decline, some chronic illnesses may also present aggravating factors, especially when different kinds of medication are involved, which can have secondary effects on some cognitive functions that are important for safe driving. Among the most frequent diseases, are visual impairments, cardiovascular diseases (CVA), diabetes and different dementing diseases, especially of the Alzheimer type (DAT) [Waller and Goo, 1969]. Conservative estimates of the prevalence of different dementing illnesses among elderly drivers raise the number to 5%-7% of all elderly drivers (around 40,000 people in Sweden alone) [Johansson and Winblard, 1991; Erkinjuntti, 1988].

Nevertheless, many older people remain very good drivers which means that age per se should not be the ad hoc criterion used to differentiate between safe and unsafe older drivers. Consequently, and in light of the age-related cognitive problems described above, it is important to study in depth the factors that influence driving behaviour in older people.

Although licensing authorities have extensive experience in assessing the fitness to drive of physically impaired drivers, [Withaar, 1997] there is a lack of standardized systematic procedures for assessing the fitness to drive of cognitively impaired persons. Assessment procedures indeed vary among countries and include either off-road or on-road assessments.
or both. However, there is a risk that the strengths and limitations of tests in use are not adequately recognised by assessors, potentially leading to errors in decisions about fitness to drive, either by allowing unsafe drivers to continue driving, or by recommending that safe drivers do not drive. There also exist risks of litigation that can emanate from inappropriate recommendations.

In conclusion, there is a disturbing lack of basic information with which to develop rational policies for deciding who is, or is not, qualified for licensure among the elderly population [Waller, 1991]. It is generally acknowledged that limitation of the privilege to drive should be based on the demonstration of impaired driving competence, rather than on a stigmatising label, such as being elderly [Drachman, 1988].

TRAFFIC SAFETY AND EFFICIENCY OF ELDERLY DRIVERS

Older drivers as a group do not have higher accident frequencies than other groups, when the statistics are corrected for yearly mileage. In contrast, they have a much higher risk of injury or fatality in traffic. Indeed, statistics from the US show that older people made up 9% of the population but accounted for 13% of all traffic fatalities [NHTSA, 1996]. This risk is, of course, higher in the less protected traffic modes. Driving a car is not only the most convenient but also the safest mode of travel for those older drivers who have intact driving ability.

However, ageing affects some capabilities that are important for driving. Both decrease in certain functions and increase in caution and wiseness show in older drivers’ accident statistics. The most difficult situations are those demanding rapid processing of large amounts of simultaneously presented data. Thus, older drivers are over-represented in specific categories of traffic accidents, arising from actions such as failure to yield the right of way, turning improperly, ignoring stop signs and red lights and starting up improperly into traffic [Stutts and Mortell, 1992]. Also when involved in an accident they are more usually than not at fault, as the following Figure 1 displays [Hakamies-Blomqvist, 1994]:

![Figure 1: Proportions of single-vehicle-accident drivers, drivers at fault in a collision and drivers not at fault in a collision by age group in Finland in the year 1984-1989, N=769](image1)

Older drivers have no particular problem with automatic processes, which place limited demands on their attentional capacity and generally occur under highly predictable conditions of traffic and weather. Non-automatic processes, in use with unpredictable or unfamiliar demands such as turning, merging, collision avoidance or driving in adverse weather, are more challenging for older drivers. Therefore, elderly drivers are specifically over-represented in intersection accidents, such as turning left across a lane of traffic (turn
right in left-driving countries), failing to yield the right-of-way and/or overlooking traffic
signals [Garber and Srinivasan, 1991; Viano et al, 1990] and being hit at high speed by a
vehicle coming from the drivers side. This trend is also represented in Figure 2.

Other cognitive and behavioural problems related to elderly drivers that are reported in the
literature include:

- stopping on green lights;
- making sudden stops without apparent reason;
- coasting to near stop in moving traffic;
- delay in changing lanes when an obstacle appeared;
- drifting into other lanes;
- misinterpretation of traffic signs;
- requirement of repeated step by step directions.

These types of error behaviours have mainly been associated with decline in sensory,
perceptual and visuo-spatial functions as well as in attentional and executive functions
[Johansson, 1997].

The elderly also tend to be overly involved in accidents resulting from changing lanes,
merging or leaving from a parking position. The situation seems to be exacerbated when the
driver reaches the age of 75 [Brainin, 1980].

The analysis of all the cognitive and behavioural error types and the actions required to
compensate for them is beyond the scope of this section and will be realised systematically
during the project’s execution.

On the other hand, demented patients have been found to have 4.7 more times more chance
of having a car accident than the rest of the population [Withaar, 1997]. Also, a three-fold
increased accident risk was found for persons over 60 suffering from cardiovascular
diseases [Waller, 1967]. Elderly drivers with diabetes were found to have a 2.6-fold increase
in risk of a traffic accident; the risk increasing to 5.8 in insulin-treated diabetes [Koepsell et al,
1994]. It has been calculated [Sjoergen, 1994] than in 1 out of 5 fatal crashes in the elderly,
medical impairment - such as that caused by cardiovascular disease, diabetes or epilepsy
was probably an underlying cause. Still, current assessment tools do not allow the detection
of people suffering from early dementia or silent stroke, thus leading to enhanced traffic risk
for particular elderly drivers.

**DEFINITION, CLASSIFICATION AND DRIVING COMPETENCE OF
ELDERLY DRIVERS**

Data in the literature suggest that decline in performance begins in the late 50’s, and visual
changes usually begin much earlier. ‘Older’ is probably most often defined as over 65,
although some studies classify drivers in their late 40’s or early 50’s in this category.
However, the 65-and-older category can be misleading. Because the curve showing
increased crash risk is accelerating, it can be argued that drivers in their 60’s are, as a
group, qualitatively different from those in their 70’s and certainly different from those in
their 80’s.

Consequently, some investigations have attempted to classify drivers into several older
groups such as young-old (55-64), middle-old (65-74), old-old (75-84) and very-old (85 and
older). Such classifications can be useful as reminders of the differences among the various
groups, but it is important to remember that individuals may or may not adhere to the group norms.

Many models have been constructed to explain the problems of elderly drivers [Brouwer and Ponds, 1994; Hakamies-Blomqvist, 1994; NHTSA, 1989]. The ageing process involves biological changes, which can have longer-term implications. As most of the information to be processed during driving a car is visual, it is important to know to what extent the different functions of the visual system change with age: the visuo-sensory function, the visuo-perceptual function and the visuo-spatial function.

The relevant problems may come from any of the domains below:

- Sensory and motor functions deteriorate with age. Static and dynamic visual sensitivity shown an age-related decline, with the greatest effect on dynamic sensitivity. Although dynamic acuity is rarely considered in studies concerning ageing and driving, it has been found to be a better predictor of safe driving.

- Therefore, in case of an emergency, the reaction time to external stimuli (e.g. seeing the other car, moving foot from gas to brake pedal) is higher. The average person in his/her 80s has a reaction time in response to light that is 7.6% slower than that of the average teenager. The response to sound is 9.2% slower for the aged and 11% for brake reaction time [Kent and Novonty, 1961]. Furthermore, a young driver can lift the foot from the gas and apply brake pressure a quarter- or a half-second faster than an older individual [Wellford, 1977].

- High order visual and cognitive impairments are also related to age. They are much more difficult to recognise and evaluate. They include, among others, deficits in visual perception, visual search and analysis, selective attention, divided attention and flexibility of attention. The elderly also seem to exhibit poorer performance in synchronised tasks.

- Decline in psychomotor performance, information uptake speed and reaction time.

- Decision making impairments.

- Specific ageing-related cognitive and perceptual disabilities (such as Alzheimer’s disease and cerebrovascular diseases, diabetes, renal disease) and multiple small cerebral infacts (‘silent strokes’).

- Confused messages to other driver cohorts.

- For example, elderly drivers often approach intersections slowly and decelerate almost to a halt before merging. This is most naturally interpreted by other drivers approaching on the main road as signalling an intention to stop and to respect right-of-way thus being completely unprepared to start avoidance manoeuvres when the elderly driver’s vehicle nevertheless suddenly accelerates into the intersection area.

**THE CONCEPT OF AGILE PROJECT (QLRT-2001-00118)**

The problems highlighted above may be solved only through a systematic and integrated solution. AGILE is a project recently accepted for co-financing by the Quality of Life programme of the European Commission, which aims to develop a new set of training, information, counselling and driving ability assessment and support tools for the elderly, evaluating their full range of physical, cognitive, behavioural and interactional abilities and not just checking a few sensory and motor functions (as is currently the case). This project focuses on two key milestones: developing the required knowledge to establish rational
policies for delivering certification of fitness to drive and helping as much as possible older age groups to continue driving safely as enhanced mobility leads to increased well-being for them [Hakamies-Blomqvist, 1996].

This is approached through a number of intermediate objectives:

- To establish a clear identification of elderly problems in relation to various driving tasks and an aetiological classification of their traffic accidents.
- To select a proper set of elderly driving ability assessment criteria (using both neuropsychological, physiological and behavioural parameters) and quantifiable thresholds for them.
- To develop a low-cost pre-screening tool for rapid assessment of elderly drivers by themselves, their family doctors or other health care professionals either in interviews or even by mail.
- To develop an elderly drivers’ assessment parameters database to be used as a knowledge repository and expertise basis for relevant assessment tools and decisions.
- To develop an integrated driving assessment system for the elderly, including all necessary assessment tools, such as a neuropsychological test battery, driving simulator scenarios and an on-road test, to be used in a modular way for elderly that seem to have particular difficulties in driving.
- To develop a reference test drive scheme to validate the reliability of the above tools.
- To develop a reliable and efficient decision and consultation expert tool, to assist the elderly driver evaluator to reach a decision and provide help to the elderly, by combining the outcome of various assessment tools.
- To develop a standardised pan-European elderly drivers assessment procedure.
- To verify all criteria, tools and methods developed through field tests with an appropriate sample of elderly users in different European countries and regions.
- To verify the cost-effectiveness and viability of the proposed methods and tools.
- To develop quantifiable and precise, inclusive and permissive design guidelines for elderly compatible car design and the development of new, more appropriate driving aids for them.
- To develop appropriate training and consultation courses to help the elderly overcome their driving problems.
- To enhance acceptance among the elderly of the proposed assessment strategy as well as to promote positive messages through public awareness of elderly drivers’ capabilities, averting current negative stereotypes, and establishing compensatory policies for those who would eventually be excluded from driving.

It should be emphasised that the assessment methods targeted are not meant to present a new barrier for elderly drivers, but instead should simplify the assessment process for most of them and help the rest to find appropriate methods and aids to allow them to remain safe drivers.

Of course, ultimately such an approach would still reasonably and fairly exclude from driving those elderly people that pose a risk to traffic safety and to themselves, while keeping their number to a minimum, and offering them support and access to alternative mobility policies (e.g. public transport passes).
To realise such a challenging task and achieve the targeted goals, a multi-disciplinary team of 13 Participants, representing 7 European countries, has been formulated. It includes participants with strong bioengineering/clinical research that develop assessment methods and tools (AMAP, IFADO, COAT), E&D driver assessment centres (CARA, AV/GOCA, NIRH), Transport Research Institutes that specialise in E&D issues (HIT, IAT, VTI), a car manufacturer (CRF), assessment tools developers (PSYTEST, FOERST) and a multinational federation of driving schools (EFA).

The work will start with the aetiological analysis of elderly driving related problems, by conducting a literature and accidentological survey, performing interviews and questionnaire surveys with experts (over 30 experts, Europe-wide) and users (400 elderly from 4 EU countries) and user observations. From the analysis of the gathered data an analytical driving task-based elderly driving problems matrix will be composed and critical scenarios for testing and further considerations will be drawn. The final outcomes will be discussed and optimised in a pan-European workshop with at least 30 external experts participation.

In parallel, a state of the art review on existing driving assessment criteria, methodologies and tools will be performed and, combined with previous results, will lead to the selection of driving assessment parameters and decision criteria for all the elderly as well as specific ones for particular elderly cohorts (i.e. elderly with particular neuropsychological impairments).

The above knowledge will be transformed in an elderly drivers assessment parameters database, including also a high number of support assessment cases and assessment criteria application guidelines, as well as the development of a paper and pencil rapid pre-screening tool, aimed to help older drivers to make self-assessments or as a preliminary tool for health care professionals to help them identify those older drivers who might need more thorough evaluation.

A number of existing and new (developed within the project) driving assessment tools will be combined, including a neuropsychological test battery, driving simulator scenarios and short on-road tests. Furthermore, a standardised reference test drive will be developed, for use as a benchmark against the above and other evaluation tools.

The above tools will be integrated and, in combination with a relevant decision and consultation expert-based tool, will support a standardised and modular driving assessment procedure.

Verification Pilots in 6 different sites will be used to verify the most important criteria as well as to test the developed tools and methodologies with around 100 elderly in each of 3 countries, including North, Central and South European regions.

Project results will support also the development of quantitative and specific design guidelines for elderly inclusive and permissive car design, a flexible and easily personalised training course, specifications of new aids to support elderly drivers and a standardisation proposal for a pan-European driving assessment policy.

The AGILE concept is graphically presented in the following figure.
Figure 3: AGILE Assessment Procedure diagram

It consists of the following steps:

- A **pre-screening** of those elderly drivers who enter the system on medical or other grounds (for example, if the family doctor suspects a problem with driving, or if the person him/herself has concerns) by a paper and pencil tool to indicate which ones require further screening.

- A **screening** of those requiring further evaluation by a specialised centre, including deeper medical evaluation, neuropsychological tests, simulator test and a short on-road test. The sequence, type and duration of those tests may be differentiated according to the findings of each assessment tool.

- The **overall assessment procedure**, and especially the in-depth screening, will not only focus on identifying the current problems of the elderly but **also to act as predictors of future problems**, that is to identify possible deterioration of key abilities to come in the near future (since pre-screening and screening can not be realised too often).

The final decision would alternatively be:

- **Fit to drive without restrictions.**
Fit to drive, but for a limited time duration (need for re-evaluation).

Fit to drive with restrictions (i.e. only in a limited area, no highway driving, no night driving, etc.).

Fit to drive with car adaptations and / or aids.

Training needed before final decision.

Unfit to drive (but alternative compensations and support offered).

EXPECTED IMPACTS OF AGILE

In 1986 in the US traffic deaths of those aged 65+ accounted for about 13% of all traffic fatalities, which was roughly in proportion to their share of the population (12.1%). However, only ten years later, in 1996, elderly persons’ share of fatalities already had reached 16.9% [FARS for traffic fatalities, US Bureau of Census for population estimates], while their share in the population did not increase markedly from 1986 (12.8% in 1996 as compared to 12.1% in 1986). A conservative estimates prediction of fatalities enhancement from US [Burkhardt et al, 1998] is shown below:

Figure 4: Projection of fatalities involving older drivers in the US from 1995 to 2030

The situation in Europe seems to be the same [Hakamies-Blomqvist, 1996]. In response to this problem, different European countries adopted different policies, from neglecting it (keeping driving license validity unlimited, such as in Belgium, France and Germany) to imposing general screening of the population by inadequately trained GP’s, without specific tools and at arbitrary ages (i.e. at 45 in Spain!, 65 in Greece, 70 in the Netherlands and Finland, etc.). The medical checks to renew them vary between 2 (for Switzerland, after 70 years of age) to 3 (for Luxembourg) and 5 (for Finland, Spain, etc.) years.

These random and differentiated policies lead either to the inclusion of few dangerous elderly drivers on the road or to the unnecessary limitation of the mobility and autonomy of others, who just can not sustain the psychological and other burden of too frequent and/or too complex assessment. It should be underlined that more than half of the people over 75 tend to lose their driving license today in countries with the periodic renewal system [Hakamies-Blomqvist et al, 1995].
AGILE aims to rationalize and standardise Europewide such policies by providing the necessary scientific tools and data to find “whose accidents are older drivers accidents?”, in other words the few ones among the elderly group that really need help and further assessment.

By using AGILE assessment tools to identify early on the major factors governing the elderly driving behaviour deterioration (i.e. pre-dementia, “silent” stroke, etc.), the relevant problems may be delayed, whereas most elderly (who have no major disabilities) will keep on driving without having to undergo complex assessment procedures, leading to many more years of safe driving and social integration.

The thorough evaluation of those elderly who suffer from such driving-related illnesses has also a diagnostic capacity, revealing the reasons for unsafe driving behaviour and thus allowing driving instructors and aid developers to approach the problem with a focus on remediation of the deficits, leading to greater autonomy, safety and quality of life. Today at least one out of every two persons over 75 renounces driving because of fear of the assessment procedure, self-experienced driving problems or simply lack of an adequate support mechanism.

Around 20% of the time of carers and relatives is spent to transport elderly people to their destinations [WHO, 1995]. A big part of this amount could be saved by helping them to drive for longer periods safely, thus lightening also the relevant social funds expenditure.

By targeting reliability rates of over 95% for its assessment tools, following a causal approach (i.e. not only fit / not fit to drive, but also what is the problem and how to fix it) and aiming at a thorough evaluation within 1-2 hours (instead of 3-8 hours which is today’s norm), the project works towards a revolutionary new assessment procedure.

CONCLUSIONS

An important part of the risk of the elderly driver groups is attributable to patterns of functional deficits related to certain illnesses whose prevalence increases with age, especially illnesses leading to cognitive deteriorations, such as the different dementias. The early recognition of signs of such illnesses and the support and eventual (maybe later) exclusion of such drivers from the traffic, together with training and adaptation support to some others (ranging from 3% to 5% only of the elderly population) may lead up to a 60% reduction of road accidents in cross-roads and 40% for rear-end collisions [Hakamies-Blomqvist, 1994], thus significantly enhancing road safety.

It can be reasonably expected that the gradual transition of older drivers from a minority group with special needs and habits to one of the important subgroups of drivers will affect the dynamics of the whole system, including the behaviour of other road users. An occasional older woman driving slower than the speed limit may be a source of irritation for others, but there is little point in protesting against the driving style of, say 30% of one’s fellow drivers. The increasing probability of having to interact with an older driver may elicit profound changes in the behaviour of all drivers, but may also cause for an intermediate period tension and strains between the different driver cohorts on the road. AGILE awareness campaign of the elderly drivers’ needs and abilities is hoped to help improve the patterns of interaction among these different traffic participants.

The scientific work and public awareness actions targeted by AGILE are aiming to promote better relations and understanding between elderly people and the rest traffic participants; abolishing the todays negative stereotypes of “elderly drivers” (as slow, “blind” and dangerous) and promoting the positive aspects of the driving behaviour of healthy elderly people. That, together with their enhanced mobility through driving, is expected to greatly
contribute to the quality of life and the dignity that we all deserve in the late years of our lives.

REFERENCES


elderly