Accident Analysis and Prevention 66 (2014) 104–113

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Safe mobility for elderly drivers—Considerations based on expert and self-assessment

Thomas Broberg[a,b,*], Tania Dukic Willstrand[c]

[a] Chalmers University of Technology, Applied Mechanics, Vehicle Safety, Göteborg, Sweden
[b] Volvo Car Corporation, R&D, Volvo Cars Safety Centre, Göteborg, Sweden
[c] Swedish National Road and Transport Research Institute (VTI), Human Factors, Göteborg, Sweden

ARTICLE INFO

Article history:
Received 22 August 2013
Received in revised form
18 December 2013
Accepted 7 January 2014

Keywords:
Elderly
Drivers
Older
Traffic safety
Mobility
Automotive
Driver behaviour
Human factors
On-road assessment
Self assessment
Speed adaption
Attention
Estimator categories
Adequate estimator
Over-estimator
Under estimator
Active safety
Preventive safety

ABSTRACT

To further understand the needs of the growing population of elderly drivers and create solutions for safe mobility it is important to understand the driving scenarios and aspects in day to day traffic that may be of challenge for this group. More so, individual differences in how drivers perceive their own driving ability may have an effect on how individuals limit their mobility and/or increase their exposure to risk situations, with a potential negative effect on safety.

In this study two sets of assessments have been used in order to identify scenarios and aspects needing consideration in creating safe mobility for elderly drivers; an expert assessment using on-road driving together with assessments through semi structured in-depth interviews. This combination also enables categorisation of the drivers, comparing their own perception of their driving performance with the expert assessment based on actual on-road driving. Four different categories of drivers were identified: adequate (positive), over, under and adequate (negative) estimators.

A number of important aspects were identified in the study. Adapting speed to the situation and driving too fast, especially on straight roads in the city, is one aspect. Seeking the attention of other road users at intersections and roundabouts is another important consideration identified.

Awareness of difficulties related to speed adaptation and attention was low amongst all the driver categories. However, a difference in attitude was seen in the categories with a more humble and acceptant attitude amongst the adequate and under estimator groups, as compared to the over estimators suggesting that the aspect of attitudes is another important factor for consideration.

1. Introduction

The number of senior citizen car drivers are increasing as demographics of the world is changing with a population that is growing ever older (United Nations Department of Economic and Social Affairs, 2009; European Commission, 2010; Statistiska Centralbyrån, 2013). Daily individual mobility is a necessity for autonomy, independence and quality of life in many regions of the world today and this need will most likely increase as society is developing further (Cobb and Coughlin, 2000). With this in mind, questions related to safety and a possible increase in number of collisions and fatalities on our roads have been raised (National Transportation Safety Board, 2010). General statements as to what and how elderly drivers do in traffic in relation to their own, as well as to third parties safety, are frequently appearing in our ever so informative society today. However, one key to adequately addressing the issue of safe mobility for elderly drivers is to further understand scenarios and situations in everyday traffic that are difficult, or perceived as such by the drivers themselves, as this may make it possible to design and engineer vehicles and infrastructure promoting mobility and increase in safety for this important and growing part of the population. There are studies showing the benefit of individual mobility for seniors, not only from an individual perspective but also from a socio-economic standpoint (European Transport Safety Council and Hakamies-Blomqvist, 2003). Furthermore, actual loss of mobility amongst elderly adults may have negative effects in terms of social activity (Marotolli et al., 2000) and may even lead to states of depression (Fonda et al., 2001).

* Corresponding author at: Volvo Car Corporation, R&D, Volvo Cars Safety Centre, 40531 Goteborg, Sweden. Tel.: +46313255171.
E-mail address: thomas.broberg@volvocars.com (T. Broberg).

0001-4575/$ – see front matter © 2014 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.aap.2014.01.014

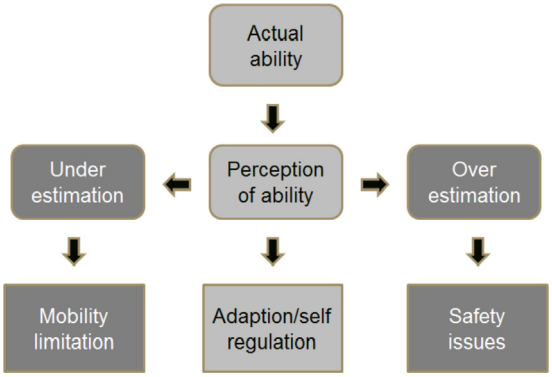

Fig. 1. Illustration of how perception of ability may lead to aspects of mobility and safety.

Some of the human factors affecting driving performance may change with age. Knowledge and experience improve with more years behind the wheel whilst processing of information and other cognitive abilities may decline (Parasuraman and Nestor, 1991; Charness and Bosman, 1992; Hartley, 1992; Salthouse, 1982). In addition lifestyle, as well as motives and attitudes may change when moving into the autumn years (Gregersen et al., 2004; Kaiser and Oswald, 2000). The awareness of these human aspects changing may differ amongst individuals as it may be a gradual change over years for healthy elderly people. Most of the times elderly drivers are aware of their limitations and impairments leading to an adaptation of their behaviour, i.e. avoiding situations such as driving at night, on wet roads, and in busy traffic (Charlton et al., 2006). Stutts et al. (1998) found that drivers with impaired contrast sensitivity drove less while elderly drivers with impaired acuity tended to avoid risky situations. Adapting their behaviour seems to be a general process used by drivers in general, and by elderly drivers in particular, in order to face both inherent changes influencing their performance but also as a reaction to unforeseen changes in the traffic environment. However, the ability to appraise your own driving performance adequately can have an effect on your adaptation (De Craen et al., 2007) which may affect both safety, as well as mobility. The safety aspect may be compromised if overestimating your driving performance leads to an increase in your task demand and thus increased risk to loss of control (De Craen et al., 2007, Fuller, 2005). Mobility on the other hand may be negatively affected resulting in premature driving cessation and unnecessary self-regulation if a driver's confidence in their own capability is low, i.e. underestimating actual performance (Siren and Meng, 2013). Fig. 1 is an illustration of how perception of ability may lead to aspects of mobility limitation and safety issues if not in line with actual ability. Good awareness of your own ability ensures suitable adaption which may have a positive effect from a safety perspective without too high limitation on mobility. Even though many elderly drivers may have good perception of their ability as drivers, self-regulation may not cover all aspects or driving scenarios (Baldock et al., 2006).

If mobility is a benchmark for quality of life, underestimation of ability may lead to unnecessary self-limiting behaviour. Some drivers, particularly women, often relinquish driving early (Meng and Siren, 2012). Other drivers continue to drive despite cognitive and physiological issues affecting their driving (Tuokko et al., 2007) overestimating their ability, not necessarily applying self-regulating strategies creating an increased exposure to safety related issues in traffic (Fig. 1).

To meet future needs and develop supportive vehicle technologies, designing driver training or to further develop the infrastructure, knowledge of elderly drivers' ability from an objective, as well as subjective evaluation is required. Hence, the overall objective of this study was to identify driving situations that need consideration in order to improve safe mobility for elderly drivers. The specific aims were to study scenarios and aspects identified by objective assessment and discuss in relation to subjective assessment and attitude, taking different categories of drivers into account.

2. Method

An on road driving task using expert assessment, together with visual and cognitive tests and subjective driving assessment by in-depth interviews was performed for 40 drivers aged 70 years or older.

2.1. Recruiting participants

The participants were recruited through two senior citizen organisations, National Pensioners' Organisation and the Swedish Association for Senior Citizens, in the Gothenburg area of Sweden. An invitation letter and information about the study sent to the senior citizen organisations generated a list of 80 volunteers. From the list, 40 drivers were contacted via telephone and recruited to participate. The selection criteria were based on age; the oldest subjects were contacted first, and a balance in gender. Participants had to hold a valid driver's license and still be active car drivers, i.e. not to have ceased driving completely. They also needed to fulfil the visual acuity requirement of 0.5 binocular, required for a drivers licence holders in Sweden, and not have any medical issues that may affect their driving, i.e. dementia. All participants were screened during the initial contact and further checked before the on-road driving assessment.

2.2. Procedure

The procedure consisted of three parts beginning with visual and cognitive tests followed by on-road driving and finally an in-depth interview. Participants were rewarded with a flower voucher after completion. The procedure in total lasted approximately 3 h. All participants conducted the entire procedure without any issues and the study had been approved by a local Ethical Committee in accordance with Swedish law before commencement.

2.2.1. Visual and cognitive tests

The visual and cognitive tests were conducted by an occupational therapist and comprised a standard visual acuity test, Useful field of view test (UFOV) (Visual Awareness Inc, 2008) and Trail Making Test (TMT) A & B (Reitan, 1986).

The Visual Acuity test is a measure of spatial resolution of the visual processing system which was tested by placing the participants 6 m in front of a whiteboard with black letters. The participants had to read the letters with the right, left and both eyes, respectively.

The UFOV, which is a computer based visual-cognitive test measuring processing speeds, divided attention and selective attention was used in its complete version (Visual Awareness Inc, 2008). Targets and distractors are presented faster and faster until it is not possible to perceive the target any longer. The scores are measured in milliseconds and the shorter the score the better the performance.

The TMT A & B is a cognitive test measuring several cognitive functions like information processing speed, divided attention and flexibility (Reitan, 1986). The test is divided in two parts where numbers only, part A, and number and letters, part B, must be connected in the right order. The tests should be completed as fast as possible and are measured and scored in seconds. This test was used to detect any possible dementia tendencies among the participants.