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Older drivers: On-road and off-road test results

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ABSTRACT

Eighty-five volunteer drivers, 65–85 years old, without cognitive impairments impacting on their driving were examined, in order to investigate driving errors characteristic for older drivers. In addition, any relationships between cognitive off-road and on-road tests results, the latter being the gold standard, were identified. Performance measurements included Trail Making Test (TMT), Nordic Stroke Driver Screening Assessment (NorSDSA), Useful Field of View (UFOV), self-rating driving performance and the two on-road protocols P-Drive and ROA. Some of the older drivers displayed questionable driving behaviour. In total, 21% of the participants failed the on-road assessment. Some of the specific errors were more serious than others. The most common driving errors embraced speed; exceeding the speed limit or not controlling the speed. Correlations with the P-Drive protocol were established for NorSDSA total score (weak), UFOV subtest 2 (weak), and UFOV subtest 3 (moderate). Correlations with the ROA protocol were established for UFOV subtest 2 (weak) and UFOV subtest 3 (weak). P-Drive and self ratings correlated weakly, whereas no correlation between self ratings and the ROA protocol was found. The results suggest that specific problems or errors seen in an older person's driving can actually be "normal driving behaviours".

1. Introduction

The total number of older drivers on the roads is rapidly increasing (Johansson et al., 1996) and at the same time, the traffic environment has gradually become more challenging (Evans, 2004).

Medical conditions, for example dementia or stroke, may compromise driving and therefore impact on a person's fitness to drive, i.e., the medical and functional requirements for driving. Cognitive assessments may contribute to determine a client's fitness to drive, but there are no specified guidelines stipulating which assessment tools to use, nor any defined cut-off scores (Swedish Transport Agency, 2010).

Several approaches have been taken to identify unsafe drivers with cognitive impairments (Brown et al., 2005; Mazer et al., 1998; Schanke and Sundet, 2000). Cognitive tests do provide valuable information about a client's specific abilities regarding fitness-to-drive, e.g., divided attention. Cognitive off-road tests that are used to make recommendations about the driving license status of a client with cognitive impairments would thus be expected to correlate with on-road test results. The relationships between the results of cognitive off-road tests and driving performance are, however, inconclusive (Akinwuntan et al., 2002; Marottoli et al., 1998; Stutts et al., 1998). Commonly, their criterion-related validity is poor. However, the more the off-road tests simulate driving i.e., the higher the face validity, the more clinically relevant they are considered to be (Anstey et al., 2005). Although most cognitive tests do not define cut-off scores to determine whether the client is a safe driver (Dobbs et al., 1998; Reger et al., 2004; Selander et al., 2010), they do provide the assessor with information about the client's cognitive functions that may have to be further assessed during an on-road assessment (Unsworth et al., 2005).

On-road assessment is the universal criterion measurement of driving competency or driving performance (Kay et al., 2008; Odenheimer et al., 1994). However, the on-road assessment has also been criticized for low validity and reliability (Fox et al., 1998; Galski et al., 2000; Odenheimer et al., 1994). Ideally, on-road assessments should be carried out on a fixed route and assess the driving performance based on standardized observations and scoring procedures (Di Stefano and Macdonald, 2003; Fox et al., 1998; Withaar et al., 2000). To use the same car during an on-road assessment further enhances standardization (Fox et al., 1998).

Older driver related research has mostly been conducted on impaired older drivers, without investigating how their healthy counterparts perform on the same outcome variables. The

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researchers have adopted either the number of errors made in specific traffic scenarios during the on-road assessment or the overall performance of participants as outcome measurements in their studies (Akinwuntan et al., 2002; Fox et al., 1997; Schanke and Sundet, 2000). However, it has not been clear whether the errors are due to impairments or they simply are developed throughout lifelong driving, contributing to possible sub-standard performances of older drivers (Dobbs et al., 1998). There is thus a need for valid evaluation methods of driving performance in this group. However, despite being the gold standard, the on-road assessment itself and its role in the decision of pass or fail have not been thoroughly studied. Hence, it is important to identify older drivers' characteristic driving errors among experienced and fit to drive persons, in order to improve on-road assessments for clients with cognitive impairments and declining competences. By exposing fit to drive older drivers to the same on-road and off-road tests that clients with cognitive impairments take, "normal" driving behaviours on a standardized on-road assessment can be revealed. In addition, their performances on cognitive tests may provide reference values. Our primary objectives were thus to investigate what types of driving errors are characteristic for older drivers without cognitive impairments affecting their fitness to drive, and to identify any relationships between off-road and on-road tests results.

2. Methods

2.1. Participants

The participants were recruited from the Vehicle Registration Office in Sweden. From a list, 394 randomly selected 65+ old individuals with a registered vehicle were approached by mail. Of those, 157 did not reply (non-responders) and 110 were not interested to take part in the investigation (42% men, $N = 46$), while 127 were interested to participate. Of these 127, 98 were selected on a first come-first serve basis. No data were available on the 29 who were not selected apart from their gender (59% men, $N = 17$) and that they were 65+. The 98 participants were interviewed by the first author. Eight persons did not fulfil necessary physical and cognitive fit-to-drive requirements for safe driving according to the Swedish Transport Agency guidelines (Swedish Transport Agency, 2010) and were excluded. For example, visual problems, stroke or dementia became exclusion criteria. Furthermore, an inclusion criterion was that they should still be active drivers (minimum 3000 km/year). When they were interviewed, also the presence of potential other medical conditions, e.g., heart disease, hypertension and diabetes, was checked for on a self-report basis. The remaining 90 fulfilled all inclusion criteria and agreed to participate in the study. However, five dropped out for various reasons. Hence, a total, 85 participated in the study. The participants' mean age was 72.0 (SD = 5.3; ranging from 65 to 85), 53% being male. There was no significant age difference between the sexes, viz. for males the mean age was 72.7 (SD = 5.6) and for the 40 females it was 71.2 (SD = 4.8) years. Similarly, there was no significant difference with respect to the number of years in school between the sexes, varying from 6 to 20 years (female mean = 10.9, SD = 3.3; male mean = 11.4, SD = 3.5). Of the 85 participants, 41% reported some sort of medical condition that supposedly did not affect their fitness to drive. Some reported multiple conditions, e.g., hypertension ($N = 25$), heart conditions ($N = 15$) and diabetes ($N = 5$). This group of 35 participants is henceforth labelled as DMC+ (Drivers *with* Medical Conditions). Consequently, the remaining 50 are labelled as DMC- (Drivers *without* Medical Conditions). There was no significant age difference between the two DMC-groups, for DMC+ the mean age was 73.0 (SD = 5.3) years and for the DMC- the mean age was 71.3 (SD = 5.3) years.

2.2. Procedure

The present study was approved by a local Ethical Committee in Stockholm, Sweden in accordance with Swedish law. Prior to their participation the participants received written information about the study purpose and that participation would not impinge on their driving licence. The data were collected at a driving assessment unit in Stockholm, Sweden. To guarantee that the participants fulfilled the requirements for vision, they had to undergo an examination, which included visual acuity and visual fields. They also underwent a cognitive screening with the tests TMT A & B (Trail Making Test), NorSDSA (Nordic Stroke Driver Screening Assessment), and UFOV (Useful Field of View). However, one participant did not complete the TMT B test and four participants did not complete the UFOV test. All tests are further described below. After these cognitive tests were completed, the participants filled in a self rating driver performance scale.

The driving took approximately 60 min on a fixed route (39.7 km) on public roads in a suburban district. The route is used for on-road assessments by the driving assessment unit. An occupational therapist (OT) observed the quality of the driver's behaviour, e.g., following instructions, planning, manoeuvring, lane positioning, obeying traffic rules, interaction with other road users and the attention using two scoring sheets further presented below. After each test, the OT decided whether participants passed or failed the test. The final pass/fail decision was the result of an overall impression of the participants' behaviour, based on the frequencies and severity of observed problems. The OT was blinded to their results from the cognitive tests, and whether they were drivers with or without medical conditions. A driving instructor had the safety responsibility through dual controls and gave instructions, i.e., directions to follow throughout the route. The driving instructor sat in the front passenger seat and the OT in the back seat to the right (right hand driving). Sixty-six chose to drive a manual gear shifted car, whereas the remaining 19 chose an automatic gear shifted car.

2.3. Instruments

1. The TMT (The Trail Making Test) is a cognitive test that measures visual search and sequencing, information processing speed, divided attention and flexibility (Reitan, 1986). The test consists of two subtests, A & B, completed in the shortest possible time and scored in seconds to completion.
2. The SDSA (Stroke Driver Screening Assessment) is a set of cognitive tests developed to evaluate fitness-to-drive in stroke clients (Nouri and Lincoln, 1992). The Nordic version of the SDSA, NorSDSA, was used in the present study. It has been validated with 97 stroke clients from Sweden and Norway (Lundberg et al., 2003). NorSDSA comprises of four sub tests providing six sub scores: viz. Dot Cancellation: measured in seconds to completion (maximum 15 min) and number of errors: Directions: maximum 32 points, Compass: maximum 32 points, and Road Sign Recognition, scored 0–12 after 3 and 5 min. Higher scores on Directions, Compass and Road Sign Recognition are considered better than lower. Based on results from Dot Cancellation (time and errors), Compass and Road Sign Recognition (3 min), the test provides a weighted overall score. SDSA provides clinically useful information regarding cognitive functions that are important for driving, e.g., focused and sustained attention, cognitive processing speed and the ability to attend to two visual dimensions at the same time.
3. The UFOV (Useful Field of View) is a PC-based visual and cognitive test that includes three sub tests measured in milliseconds. The first subtest measures processing speed only, while the second measures processing speed for a divided attention task and the third processing speed for a selective attention task (Edwards