

Summary:

Vision and cognitive functioning among drivers aged 70 years and older

Importance for driving performance

Estimates indicate that the risk of being involved in a traffic accident increases after the driver is 65 years of age. A possible explanation is that the increasing risk is associated with impairments in sensory and cognitive abilities, which become more prevalent with increasing age. Such impairments can reduce the ability to drive safely in traffic.

The aim of the present study was to examine whether various tests of visual and cognitive impairments can identify elderly drivers believed to constitute a risk for themselves and others in traffic. 88 drivers aged 69-91 years volunteered to participate in the study.

The participants drove a standardized route in real traffic during daytime. The route included driving in a broad range of different traffic environments (roundabouts, intersections, different speed regulations etc.) for approximately 45 minutes. A trained observer sat in the car with the participants during the tour. The observer rated the participants' driving performance on six main dimensions; technical handling, use of signs/indicators, observation, positioning on the road, speed adaptation, and adaptation to traffic. A five-point evaluation scale was applied to assess performance on each of the main elements. In addition, an overall evaluation was made by categorizing the participants' driving performance as either "acceptable" or "non-acceptable". The latter signify that the driver was regarded to represent a danger to either him-/herself or to others in traffic.

The study also included measurements of the drivers' visual and cognitive functioning. Four main types of visual function were assessed; visual acuity (both high contrast and low contrast acuity); visual acuity under glare conditions (measured through the Brightness Acuity Test), central and peripheral visual field, and stereoscopic vision. Three tests of cognitive functioning were applied. Two of the tests measured cognitive deficiencies commonly associated with age-related dementia: the Mini Mental Status Examination and the Trail Making Test B. The Useful Field of View test was applied to measure perception and attention in the peripheral field of view.

About half of the participants (48 %) were considered to have a “non-acceptable” driving performance. There was a weak association between driving performance and age; drivers aged 75 years and older were judged to have a slightly poorer driving performance compared to those aged 69-75 years. Four different tests of visual and cognitive functioning turned out to be better suited as predictors of driving performance than age was. These functions were:

- Participants with reduced visual acuity under glare conditions were more likely to be evaluated to have a “non-acceptable” driving performance. Having reduced acuity under glare conditions is usually a symptom of cataract, which involves a clouding of the lens of the eye. This causes the lens to become less transparent, resulting in unsystematically spreading of light in the eye before the light reaches the retina. The final result is poor visual acuity. Visual acuity under glare conditions was assessed using the Brightness Acuity Test (BAT-HI).
- Having a defect in the *central* field of vision on at least one eye was associated with a “non-acceptable” driving performance. Such defects are usually caused by age-related macula degeneration (AMD). AMD is a disorder of the retina, in which the central part of one's vision is blocked as if a blurred area or, in the worst case, blind spots had been placed in the center of the picture. This results in difficulties with reading signs, identify objects and minor movements, and reading the instruments in the car. Abnormality in the central field of vision was measured using the Amsler Grid pattern.
- Late detection of objects in the surroundings (slow processing speed), difficulties to keep attention on two objects at the same time (impaired ability of divided attention), and problems to hold attention to one element among several (impaired ability of selective attention) showed a clear relationship with a “non-acceptable” driving performance. These functions were measured by the Useful Field of View (UFOV) test.
- Drivers with an indication of cognitive impairment/dementia measured through the Trail Making Test B (TMT B) were likely to be considered to have a “non-acceptable” driving performance.

The results indicate that all of the four tests had a “screening function” concerning driving performance. This means that drivers falling below a minimum level of visual acuity under glaring, central vision, or cognitive functioning, are very probable to be evaluated to have a “non-acceptable” driving performance. Applying these four tests of visual and cognitive functioning as a diagnostic tool would correctly have identified 78 % of all the participants with a “non-acceptable” driving performance.

Each of the four tests had an independent predictive value, meaning that they to a large extent identified different participants with "non-acceptable" driving performance. This demonstrates that the tests capture different aspects relevant for driving performance. As a consequence, the best prediction of driving performance can be obtained through the use of all four tests.

The tests did not identify all of the participants who were considered to have "non-acceptable" driving skills. This is expected, since the visual and cognitive functions measured in this study are not believed to be the only factors resulting in an impaired driving performance.

The fact that the tests wrongly predict that some participants have a "non-acceptable" driving performance is more problematic. Especially, the Amsler Grid test made such a prediction error. This suggests that defects in the central field of vision do not necessarily result in a poor driving performance. A possible explanation is that the participants' central field of vision was classified as either "normal" or "abnormal" on basis of the Amsler Grid test. This is probably a too broad method of classifying abnormalities in the central vision. It is therefore recommended that future studies should examine how a more narrow classification, e.g. a separation between minor and major defects, affects the relationship between driving performance and defects in the central vision.

The results leave no doubt about the predictive ability of the four tests. None of these tests are a part of the medical examination drivers aged 70 years and older have to go through today in order to maintain their driver license. The four test can easily be included in future medical examinations, especially since they are relatively easy to administer concerning the time and equipment needed.

It is, however, important to note that further research is needed before the tests can be applied as diagnostic instruments for elderly drivers. It is recommended to use larger and more representative samples in order to both examine whether the findings are replicated and to calculate more accurate cut-off scores for estimating the minimum level of functioning required to drive safely.

Another question relates to the validity of the assessment of driving performance. Is, for example, driving performance predictive of future accident involvement? It is not possible to answer this question in the present study. Consequently, future studies should examine whether the tests also can predict accident involvement.