Part two in this series reviewed the use of visual acuity (VA) as a means of screening drivers’ vision (Optician 17.12.10). Another visual function that a clinician might instinctively expect to affect driving performance would be the extent of the visual field. There is evidence that general mobility is affected by a reduction in the visual field and, as the driving task is considerably more demanding due to the constant and rapid change in the environment and the need to scan peripheral areas for potential hazards, one would expect visual field to play a significant role in accident rate/driving performance.

However, for all the reasons provided in the earlier article on VA relating to the frequency of accidents and the lack of measurement of visual factors at accident scenes, the relative impact of field loss on accident rate is not clear cut, although stronger than the relationship for VA.

In addition to the limitation imposed by the lack of accident statistics, there are compounding factors when considering visual field assessment in relation to the driving task compared with the assessment of VA. Examples of such factors would be:

- The difficulty in repeatability of visual fields where a loss is present even on the same machine
- The potential for an initial ‘learning’ factor that may skew data
- The relative importance to the driving task of the location of any errors detected
- The specific visual field instrument and settings used.

As a result, determining a cut-off point for the extent of the visual field in order to decide on safety to drive is once again extremely difficult. To introduce a degree of standardisation into the system, as mentioned in the first article in this series on regulation, the recent EU directive on driving licences specifies visual field requirement for drivers. These standards have been agreed by a medical panel advising the commission and are as follows:

**Group 1 drivers**
The horizontal visual field should be at least 120º, the extension should be at least 50º left and right and 20º up and down. No defects should be present within a radius of the central 20º.

**Group 2 drivers**
The horizontal visual field with both eyes should be at least 160º, the extension should be at least 70º left and right and 30º up and down. No defects should be present within a radius of the central 30º.

This standardisation is extremely helpful by defining the limits; however, the specifications are not prescriptive as to how fields should be measured, what target size may be most appropriate etc. This provides scope for variation in testing and interpretation and, in the UK, the Driver and Vehicle Licensing Agency (via members of the Honorary Medical Advisory Panel on Driving and Visual Disorders) has the task of resolving any queries that may arise due to the assessment process.

**Do visual field losses affect driving?**
As with VA, the evidence for the impact of visual field loss on accident rate is not conclusive but is certainly stronger. Early reports by Burg1 and Council and Allen2 reported no relation between the extent of the horizontal visual field and accident rate. The technique for field assessment in these studies was, however, limited and inconsistent, and simply provided a maximum extent for the horizontal field.

There have been a number of subsequent studies looking at different aspects of visual fields and driving performance and/or accident rate and using different methodologies for testing visual fields. The following is a brief selection and indicates the variability in outcomes.

The study by Johnson and Keltner3 using standardised automated field screening is still the most frequently cited reference to the effect of visual field loss on accident rate. As part of a study to review the value of field screening in driver assessment using automated perimeters, the authors undertook visual field assessments on 10,000 applicants for driving...
With fields indicating severe central field impairment were six times more likely to cause an at-fault crash and four times more likely to cause a crash, regardless of fault, than were those with fields indicating no impairment. In the study, visual field loss was defined monocularly and it was suggested by the authors that it is the binocular visual field assessed by conventional automated perimeter that is most likely to evaluate risk for adverse events such as falling, problems locating objects, and vehicle crashes. It is interesting to note from the data that it is the poorer eye’s visual field characteristics that were significantly associated with crash involvement rather than the field characteristics of the better eye.

A more recent study by Haymes et al. using an open-road task demonstrated that patients with glaucoma with slight to moderate visual field impairment were able to perform many real-world driving manoeuvres safely. However, they were six times as likely as subjects with normal vision to have a driving instructor intervene for reasons suggesting difficulty with detection of peripheral obstacles and hazards, and with reaction to unexpected events. A more extreme 'on road' study by Wood et al. assessed the driving performance of 22 persons with hemianopia and eight with quadrantanopia against a group of visually normal drivers. All drivers with normal fields were rated as safe to drive, while 73 per cent of hemianopic and 88 per cent of quadrantanopic drivers received safe ratings. It was found that the on-road performance problems of the visually impaired drivers were:

- Difficulty with lane position
- Steering steadiness
- Gap judgment.

Clinical characteristics associated with unsafe driving were slowed visual processing speed, reduced contrast sensitivity and visual field sensitivity.

The evidence therefore suggests that loss of visual field does have an impact on driving performance and on accident rate. The effect, however, may not be as great as would have been expected intuitively. There is limited evidence that it is loss of lower peripheral visual field and within the central 30° that has the most impact.

### Useful field of view

An extension of visual field assessment in relation to driving is the Useful Field of View (UFOV). This test takes into account visual processing speed and higher order processing skills such as divided visual attention and has therefore been suggested as more appropriate to the driving situation. Performance on the test is a function of:

- The minimum target duration required to perform the central discrimination task
- The ability to divide attention between central and peripheral tasks
- The ability to filter out distracting stimuli.

An early study by Ball et al. demonstrated that the size of the useful field of view had high sensitivity (89 per cent) and specificity (81 per cent) in predicting which older drivers had a history of crash problems. Older adults with substantial shrinkage in the useful field of view were six times more likely to have incurred one or more crashes in the previous five-year period.

The authors reported that eye health status, visual sensory function, cognitive status, and chronological age were significantly correlated with crashes, but unlike UFOV were relatively poor at discriminating between crash-involved versus crash-free drivers. They concluded that the identification of a visual attention measure highly

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**Accurate fields assessment may detect conditions which may impact on driving safety**

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predictive of crash potential in the elderly could provide a way in which the suitability of licensure in the older adult population could be based on objective, performance-based criteria.

Langford\textsuperscript{10} reports that performance on UFOV has been shown to have a consistent and statistically significant association with crash risk, including at-risk crashes and that, overall, poor test performance has been associated with a two times or higher relative risk of crash involvement on both retrospective and prospective bases.

However, the author goes on to state that the test is presently too inaccurate to be used as a form of age-based assessment on a simple pass/fail basis and would result in large numbers of older drivers being needlessly taken from the road. There is also an issue with standardisation of the test in order to be able to define cut-off points.

**Should visual fields be tested?**

Under the current UK driving requirements drivers are legally required to ensure that they meet the standards at all times when they drive. It has been suggested that this can be self-achieved in the case of VA by reading a number plate at a specified distance. In addition the number plate is currently performed at the driving test. This is in stark contrast to assessment of the visual fields which does not currently take place at the driving test (or at any other time unless the driver has been identified as having a specific problem) and which cannot be self-assessed adequately.

There is evidence from the Johnson and Kelner study\textsuperscript{3} that over 50 per cent of those drivers identified in the screening process as having a visual field loss were unaware of any visual problem. This again leads one to conclude that, to be part of an effective screening process, visual field assessment should form part of a general strategy to determine whether drivers meet the required standard. The evidence from this study is that the frequency of visual field loss varies with age but increases rapidly over the age of 65. Their data show that at 40 years of age approximately 3 per cent of drivers have some degree of field loss and this figure increases to some 13 per cent of drivers over the age of 65.

**How should fields be assessed?**

As mentioned previously, data indicate that it is loss in the binocular field that is most likely to correlate to accident rate/driving performance and deficit in specific areas of the visual field have been shown to affect particular aspects of driving performance. It is therefore important that the field is assessed binocularly.

There has been criticism of the current range of screeners which do not readily enable examiners to monitor the fixation binocularly and therefore prevent scanning during the test. However, little evidence is available to demonstrate what if any level of variability occurs when two monocular fields are used to determine the overall field compared to a binocularly assessed field.

The optometrist in practice would be required to assess the visual fields against the current EU standard relating to the binocular field. Where losses have been identified the DVLA would then be required to make the decision as to whether or not an individual was safe to drive with the level of field identified. The DVLA guidance on Medical Aspects of Fitness to Drive produced in February 2011\textsuperscript{11} is more prescriptive than the EU regulation in terms of measuring visual fields and states: The minimum field of vision for
safe driving is defined as ‘a field of at least 120° on the horizontal measured using a target equivalent to the white Goldmann III4e settings. In addition, there should be no significant defect in the binocular field which encroaches within 20° of fixation above or below the horizontal meridian’.

This means that homonymous or bitemporal defects, which come close to fixation, whether hemianopic or quadrantopic, are not normally accepted as safe for driving.

If a visual field assessment is necessary to determine fitness to drive, the DVLA requires this to be a binocular Esterman field. Monocular full field charts may also be requested in specific conditions. Exceptionally, Goldmann perimetry, carried out to strict criteria, will be considered. The Secretary of State’s Advisory Panel for Visual Disorders and Driving advises that, for an Esterman binocular chart to be considered reliable for licensing, the false positive score must be no more than 20 per cent. When assessing monocular charts and Goldmann perimetry, fixation accuracy will also be considered.

For those practitioners registered with the DVLA to provide visual field screening they should comply with the above requirements. For those not listed with the DVLA a decision would have to be made as to whether the visual field test being used was sufficiently rigorous to demonstrate evidence of field loss that may preclude someone from driving in line with the EU requirements.

The evidence for this would be sent to the DVLA who would then arrange for a test to be carried out to their specific requirements. It is not the role of the optometrist to determine safety to drive but to identify individuals who do not appear able to meet the standard criteria. The decision on licensing is made by the DVLA.

Conclusion
Visual field requirements have been included in the EU regulation relating to driving standards as there is evidence of a link between visual field loss and accident rate and driving performance. There is in the UK, however, no routine process in place for screening of a driver’s visual fields.

As there is evidence that people with field loss are frequently unaware of a visual problem it would make sense for a process to be put in place that assesses the visual fields of drivers at specified points through their driving lifetime that would ensure the licensing requirements were fully met, particularly as drivers are unable to self-assess their visual field status.

References
10. Langford J. Usefulness of off-road screening tests to licensing authorities when assessing older driver fitness to drive. Traffic Inj Prev, 2008;9 328-35.

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