VISUAL FIELD REQUIREMENTS IN THE USA

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Abstract

Questionnaires were mailed to all 51 Jurisdictions in the USA to gather information about the visual field requirements for driving licenses. Responses to questions and other materials were received from all. Thirty-three jurisdictions require a minimal visual field for non-commercial licenses. The visual field requirements for unrestricted license vary substantially from state to state. While most jurisdictions require more than 100 deg. of binocular horizontal field, the range extends from 30 to 140 deg. It was not possible to determine which states actually enforce the screening requirements. Only 12 states had specific rules for restricted licenses with vision field impairments and those varied greatly as well. In some cases field and acuity requirements were cross-linked on the apparent assumption that a larger field would compensate for poorer acuity. No state explicitly permits the use of field enhancement devices for meeting the standard. The data are discussed in relation to the paucity of information on the minimal visual field required for safe driving.

1. INTRODUCTION

The World Health Organization (WHO, 1980) classifies the consequences of vision loss in four levels:

1) **Disorder**: Deviation from normality in the structure of the eye or visual system
(e.g. Retinitis Pigmentosa)
2) **Impairment**: Limitation in the overall function of the visual system
(e.g. restricted visual field)
3) **Disability**: Limitation in the ability to perform a task
(e.g. driving safely)
4) **Handicap**: Limitation in the social functioning of a person
(e.g. unable to get to work without driving)

For the purpose of vision rehabilitation a person is considered to have low vision if his/her vision impairment causes disability. Vision requirements for driving, however, are typically defined at the impairment level despite the paucity of information on the relations between measures of vision impairments and driving disability. Due to the lack of reliable information, regulators, who are forced to make decisions, make rules that are quite arbitrary. Therefore, the rules vary widely from state to state, most notable with regards to the visual field (VF) requirements. It is argued that the extreme variability of these rules cannot be consistent either with public safety or with fair treatment of impaired citizens.

To some extent eye and head movements can compensate for VF loss (Danielson, 1957). It would be important to identify drivers that can or cannot apply such compensations effectively in deciding about licensing. Such identification would represent a change from impairment-based assessment to disability-based assessment.

There is a growing recognition among driving and vision professionals that fitness to drive should be defined at the disability level, because the driving task lends itself to various types of compensation for the limitation imposed by vision impairments. However, at the moment only measurements of the impairment in terms of VF loss are used for such decisions. It is interesting to note that in most states vision is the only aspect that is assessed at the impairment level. Other physical or cognitive aspects are addressed at the disability level and typically licensing decision is based on a road test in addition to clinical evaluation.

Intuitively it is apparent to all that a wide peripheral VF is needed for safe driving. While it is quite obvious that a person who is legally blind due to VF restriction (20 degrees or less in diameter) could not drive safely, it is far less obvious what size of the VF would be consistent with safe driving? Danielson (1957) evaluated 680 drivers selected to be at high risk for VF defects or with bad accident record. He noted: ”Suffice it to say that no cases were encountered in which the defective field of vision was believed to have caused an accident”. A number of other studies found no correlation between crash rate and VF deficits (Burg, 1967; Ball, Owsley, Sloane, Roenker & Bruni, 1993; Decina & Staplin, 1993). One study did find a doubling of crashes and traffic violations in people with severely reduced VF in both eyes (Johnson & Keltner, 1983).

Hemianopia, the loss of half the VF on one side in both eyes, is a distinct type of vision loss that should be considered separately from the peripheral field constriction of Retinitis Pigmentosa (RP) and Glaucoma. Unfortunately, frequently hemianopia’s effect on driving is not distinguished from other types of field loss in regulations and in studies. For example, the study of Johnson and Keltner (1983) is frequently cited as indicating that driving with hemianopia may be dangerous. However, only a couple of people with hemianopia were found in this group (Johnson, personal communication, 2000). Because many jurisdictions do not prohibit driving with hemianopia and because many patients can easily pass the VF screening, many of them are driving but their driving records are unknown.

Reviews of the literature have found that the findings are inconclusive with regards to the impact of field defect on driving safety (North, 1985). Charman (1997) similarly reported that while some studies have found correlation between visual-field loss due to RP and driving performance, others (even by the same authors) failed to find a relationship. The most recent review of the literature (Owsley & McGwin, 1999) determined that “The most prudent conclusion based on the literature may be that, although severe binocular VF loss elevates crash risk, more subtle VF impairment by itself is not likely to play a significant role in adverse driving events”.

In view of this highly ambiguous and inconclusive state of knowledge regarding the effect of VF loss on driving safety and driving performance, it is interesting to examine the licensing rules adopted by various jurisdictions.

2. METHODS

A questionnaire was mailed to the driving licensing agencies of all 50 states and the District of Columbia (DC). The questionnaire requested information regarding vision requirements for unrestricted licensure as well as specifics requirements for restricted licensure. Repeated mailings and telephone calls were required to reach all 51 jurisdictions. State-by-state data tables were used in an effort to maintain a uniform format across the states. This was not always possible due to the variability of format and level of detail of regulations.

The completed tables were then mailed back to the corresponding agencies with a request for approval or correction of the interpretation of the previous responses as they appeared in the table. Confirmation and corrections for the tables were received during 2001 and included, in many cases, updates regarding recent changes in. To date, responses were received from 47 of the 51 jurisdictions. The complete tables will appear in a book that will be published soon (Peli & Peli, in press).

3. RESULTS

Thirty-seven jurisdictions have peripheral VF requirements for licensing and four require VF screening only for commercial drivers (bus, taxi, or truck drivers) (Fig. 1).

VF required for an unrestricted license

As shown in Fig. 2, eighteen states have no requirements for VF for non-commercial drivers. Two states (New York and Arkansas) require a minimum VF only if the visual acuity standard (20/40) cannot be met. The federal government requirement for commercial drivers is for a field of 70 degree horizontally in each eye, considerably less than the requirement imposed by many states for professional or private drivers. The states can and many do require a higher standard than the minimum imposed by the federal regulations for both commercial and private drivers

In most cases the VF requirements are defined in terms of the extent of the binocular field along the horizontal meridian. Only two states Kentucky and Utah specify the extent of the field vertically to include at least 25 and 20 deg., respectively, above and below fixation. This specification is much less detailed than that used in the British regulations (2001). There was no specific treatment of central or paracentral scotoma in any jurisdiction. While the regulations may be interpreted to imply no interruption of the field along the horizontal meridian, this is clearly not the case, as all states permit driving with monocular vision, and in these cases the physiological scotoma (optic disc) will interrupt the field along the horizontal meridian.

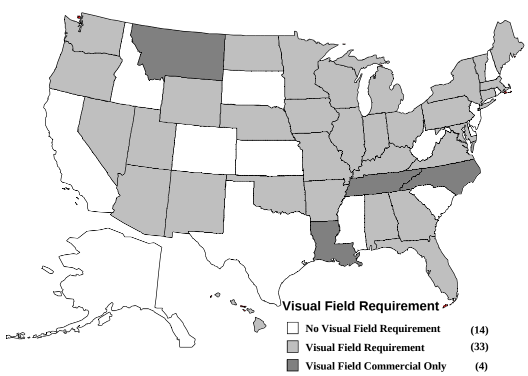
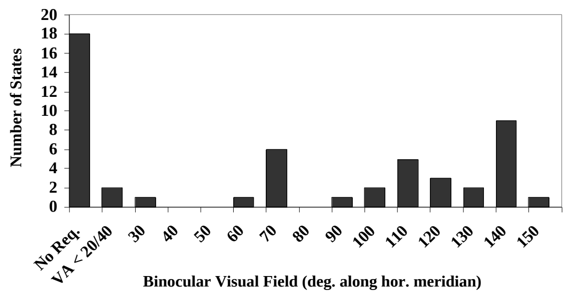


Figure 1 A map of the USA showing the states that have a VF screening requirement for non-commercial drivers (diagonal lines) and those that require such testing from commercial drivers only (gray). All other states have no field requirements for private drivers and only impose the federal requirement for commercial drivers.

Minimum VF for restricted license

Fig. 3 presents the VF requirements for an unrestricted license along with the minimal VF requirements needed for a restricted license in the 12 states that permit such licenses. As can be seen, only small reductions in the VFs are permitted for restricted licenses in these states. In some cases requirements for the extent of temporal and nasal field in each eye are specified. The state of Missouri requires 70 deg binocular VF for both the restricted and non-restricted licenses. The restrictions are imposed if one eye's field is below 55 deg (the other eye field then has to be larger than 85 deg.) and may be imposed even if the binocular field is wider than the minimal 70 deg. The reason for the monocular field requirement in the presence of binocular field is not known.

Figure 2. The number of jurisdictions having specific VF requirements for non-restricted license. Eighteen jurisdictions have no requirements and two only require a minimal field if the acuity does not meet the screening standard. Note peaks at 70 and 140 deg.



Rules about hemianopia

Most states treat hemianopic field loss as any other restricted peripheral field. Thus the requirement is only for a total horizontal extent of the field. People with hemianopia can frequently be measured to have 90 deg. with standard clinical procedure, and thus qualify in states requiring less than 90 deg of field but will fail to qualify in 22 states. In fact the temporal field may extend more than 90 deg, although a modified test procedure is required to document such a field with most clinical perimeters. Thus even a field requirement of 110 deg. might be met with hemianopia. At least one state (Utah) specifies that drivers with hemianopia be evaluated individually for driving qualification. Driving with hemianopia is explicitly prohibited in the UK and a special road test is required for hemianopia in The Netherlands.

Types of restrictions imposed

Those states that permit a restricted license for drivers with reduced VFs almost uniformly require outside rearview mirrors. In five states, mirrors are required on both sides, while in DC, only the left side mirror is required. In some states, the mirror is required on the side of the eye with the limited field (or the blind eye). No state explicitly permits meeting the VF requirement through the use of a field enhancement device (analogous to the use of a bioptic telescope to meet visual acuity requirements)

Visual fields test methods

The required VF is usually defined in terms of binocular degrees of visual angle along the horizontal meridian, however, the method of measurement is not always well defined. Measurements may be obtained by careful confrontation (District of

Columbia) or by clinical perimetry, although the specific targets are rarely specified (e.g., 6 mm target specified in Michigan, or Goldmann III4e specified in Kentucky). Most commonly the VF is evaluated using a single light on each side of the VF using the various screening devices (e.g., Optec 1000, Keyston Vision II, Stereo Optical DMV 2000). These tests are easy to defeat unless applied with great care and attention, which is rarely the case. In the most recent renewal of my driving license in Massachusetts, no VF test was administered.

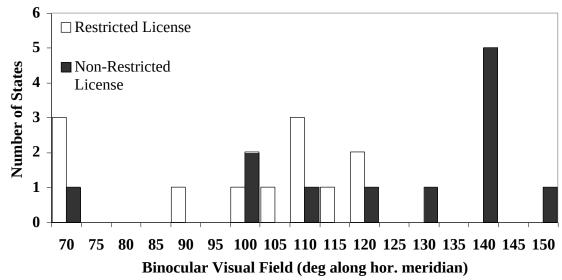


Figure 3. The distributions of visual field requirements for restricted licenses show that only a minimal reduction in field is permitted by those 12 states that offer such restricted licenses.

4. DISCUSSION

The wide variability in VF requirements found between the states is an indication of the lack of consensus in the scientific and therefore in the driving regulatory communities about the extent of VF that is needed for safe driving. Faced with such lack of consensus and reliable data, regulators are forced to make arbitrary decision. One way for regulators to make such decision is to look to neighboring states. These regional tendencies are clearly notable in the map (Fig.1). Conforming to neighboring states is clearly less than an optimal way of making decisions that have significant impact on the quality of life of many citizens and the safety of all. The large variability across states creates a situation that is either unsafe (as some states permit driving for people who should be prohibited) or it is unfair (as qualified people are denied driving privileges just because of their state of residence). It is most likely that the current status is both unsafe and unfair.

Fig. 2 show that for those states that require a minimal VF for unrestricted license, the VF requirements are distributes around the 110 deg. with additional 6 states requiring 70 deg and 9 more states requiring 140 deg. The reason for the distribution around 110 deg is not known. The requirement for 70 deg appears to reflect the federal requirement for commercial interstate drivers (70 deg in each eye), the source of this requirement is not known either. The reason for the peak in the distribution at 140 deg. is presumed to be a result of misinterpreting the Federal requirement for commercial drivers to mean a binocular field of 140 deg (the sum of two monocular fields of 70 deg). While it may seem unreasonable to make such an assumption in view of the large overlap of the VFs of the two eyes, such mistakes are not rare, even in the ophthalmic literature (Fishman, Anderson, Stinson & Haque, 1981).

A few jurisdictions have acuity-dependent VF requirements. For example in the state of Maryland a VF of 140 deg is needed for an unrestricted license. However, a field of 100 deg is sufficient for a restricted license, but only if the VA is better than 6/12

(20/40). In the District of Columbia, a VF of 130 deg is required if acuity is better than 6/12 (20/40). However, if the visual acuity is reduced (but still better than 6/21 (20/70)), a field of 140 deg is required. The rationale for such acuity-dependent VF requirements is unclear. Visual acuity loss is usually a result of loss of central vision, which, in the ranges addressed by these regulations, would only affect a few degrees around the fovea. Can such a loss interact or could it be compensated for by an increase in the required VF? Fig. 4 illustrates the relations between the views afforded with 140 and 130 deg fields and the central 10 deg of the field of view. It is apparent that the small increase in peripheral field afforded is unlikely to affect in any way the driving ability of a person suffering from modest loss of central vision.

I believe that this kind of cross requirements are derived from the computations of vision efficiency or vision disabilities used for insurance, social security, or legal compensation for vision loss. In many of these situations the visual disability is computed using a linear weighting formula such as

$$Disability = K \ (visual \ \ acuity \ \ score) + C \ \ (field \ \ score), \qquad (1)$$

where, K and C are the weighting coefficients. This formulation implies that an improvement in the VF may compensate for a loss of visual acuity and vice versa. An example of such explicit thinking is present in Fishman et al’s (1981) study on driving with RP that compared driving records with various measures of visual efficiency. They implemented such a formulation to determine visual efficiency. While such formulations that are used to compute overall visual score may be appropriate for various social or medical-legal applications, they should not be interpreted to mean that one of these functions could compensate for a loss in the other for the purpose of driving. I am aware of no evidence to support such an accounting, and therefore, they should not be applied in licensing decisions.

The VFs of both eyes are highly overlapping. Therefore, a loss of field in one eye has only a minimal impact on the binocular VF of the person. This is why all states permit people with one blind eye to drive. However, many require the remaining eye to satisfy a higher standard on visual acuity tests than that required from people with two functioning eyes. The basis for that cross-linked requirement is not known but is likely to be related to the same thinking associated with the VF cross-linked requirements discussed above. In some countries, an adaptation period of a few months is required before driving is resumed after a loss of vision in one eye. This requirement appears to be much more reasonable than the more stringent acuity requirement. However, I am not aware of any study that determined the time needed for recovery of safe driving following acute loss of vision in one eye.

While the use of bioptic telescopic devices is permitted as a visual aid for driving in 28 states, there is no equivalent allowance for a visual aid that could be used to expand the VF while driving. A few states require outside rear view mirrors for drivers with reduced VFs. However, rear view mirrors do not compensate for the loss of VF suffered by these patients. The rear view mirrors can only be used to see the rear of the car, where vision is not afforded even by the widest extent of the VF. Mirrors mounted in different ways could possibly provide VF expansion for drivers with field loss (Weiss, 1984), but such applications are neither required nor permitted in any states.

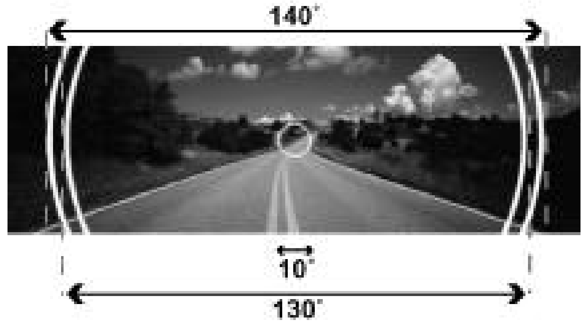


Fig. 4. An illustration of the impact of the increase in VF required in the District of Columbia for patients with visual acuity in the range of 6/12 to 6/21 on the field of view in a driving scene. The circle of 10 deg in the center represents the maximum area that might be affected to cause such a reduction in acuity.

A reversed (minifying) telescope is used to expand the VF of patients with concentric restriction. It provides an expansion of the horizontal field of view but reduces resolution. A recent study (Szlyk, Seiple, Laderman, Kelsch, Ho & McMahon, 1998) evaluated the Amorphic minifying telescope mounted in the lower part of the lens in driving. An improvement was measured, with the use of the Amorphic lens and extensive training. The need for the expansion of the lower VF covering the instruments board is not clear. However, bioptic intermittent use of a minifying telescope may be an effective way of expanding the field for driving purposes.

For patients with hemianopia prisms are typically used to expand the field of vision. In most cases, these devices afford only a small change in field of vision due to the low power of the prisms used. In addition they have not been considered as driving aids because they either relocate (or shift) the field or cause central diplopia, both of these effects result in changes of perceived direction of objects that might be considered dangerous in driving. Peli (2000) has proposed a new method for prism correction using prism segments that spans the entire width of one lens, but are limited to the upper and lower peripheral parts of the lens and thus prevents central diplopia. The high power prisms used provide a large expansion (20 deg) of the field at all positions of gaze. The expanded field is used only to alert the user of an obstacle or threat in the missing field and the threat is then examined with the unaffected central vision. These prisms have not been evaluated for driving yet, but a study is underway.

At the moment, the minimal extent of the VF needed for safe driving is largely unknown. Indirect evidence can be used to try to determine the required field. For example, the ability to drive safely at night is an indication of the ability to drive with very limited field, as the headlights provide a very narrow field of view. However, such indirect evidence is insufficient; it does not address many aspects of the driving task. Instead, there is a need for direct research on the impact of different types and levels of VF restriction driving safety. Such studies would preferably be based on on-the-road evaluation, but simulator studies that particularly challenge the field loss could be beneficial as well. Studies of patients with monocular field loss are useful because the within subject design they provide addresses the complexity of the driving task and wide range of skills among drivers. The driving records of patients with restricted fields from those states that permit their driving should be collected and compared to matching populations in other states. The data to be generated from such studies should provide a more solid basis for the determination of the VF requirements for safe driving and the possible role of vision aids for driving with reduced fields. With better information the variability in licensing requirements between states and even countries can be reduced, improving safety and the fair treatment of visually impaired drivers.

5. ACKNOWLEDGEMENT

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