
The useful field of view test: A new technique for evaluating age-related declines in visual function

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ABSTRACT: Many older adults eventually experience difficulty in everyday visual activities, prompting them to consult with an eye care specialist. In some cases, a thorough examination may reveal no clinical basis for these difficulties. New techniques for evaluating age-related declines in visual function have substantiated the existence of deficits in visual attention that are not adequately captured by standard clinical measures, and which are predictive of real world problems in driving and mobility. These new techniques may serve an important function in guiding the diagnosis, and treatment of those older adults experiencing functional visual problems.

KEY WORDS: aging, vision, cognition, attention, driving, vehicle crashes, driver assessment, mobility

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Most older adults eventually experience some degree of decline in their ability to see and process visual information, which can have a negative impact on their performance of daily visual activities. Difficulties in carrying out everyday visual tasks may lead older adults to seek help from an eye care specialist who is then faced with the challenge of determining the cause(s) of their visual problems and then, once identified, developing a treatment plan. The goal of this paper is to familiarize the optometrist with a new test, which can document visual information processing deficits sometimes found in the elderly.

History

The percentage of the U.S. population over age 65 is increasing dramatically, and by the beginning of the next century it is expected that 20-25 percent of the population in this country will fall within this age group.¹ People born today have an average life expectancy 26 years longer than those born in 1900,² and older individuals will expect and desire to maintain the high quality of life they have enjoyed during earlier adulthood. Older individuals are the heaviest per capita consumers of health care services,³ and eye care is a significant part of the services they seek. Thus, with the "graying of America," as well as the expansion of optometric coverage under Medicare as stipulated by the Budget Reconciliation Act of 1986 (HR 5300), optometrists increasingly will need to address the special visual needs of older individuals.

While there has been a substantial increase in our understanding of how visual function changes in old age,⁴ there has been relatively little work on how these visual functional changes, as measured in the clinic or laboratory, actually impact everyday visual performance. Dr. Meredith Morgan, a highly respected optometrist, vision researcher, and author, has provided an insightful account⁵ of how age-related changes affected his everyday vision, a report that has been discussed previously in this journal.⁶ One quote from Dr. Morgan's paper is especially relevant for the topic we are about to address. He states:

"I have the impression that my working visual fields, in contrast to my clinically measured fields (which are normal), are somewhat reduced . . . Objects coming from my right that I missed on casual observation sometimes suddenly appear in my field. I think I have to make a greater effort than before to perceive objects in the periphery of my field. If I give my full attention to detecting peripheral objects, as in visual field testing, my performance is excellent. But when my attention is divided, as in driving, I think that there has been a decrease in the size of my visual fields."⁵

Morgan is not alone in his impressions. In agreement with his description, survey results have indicated that compared to young

adults, older adults are five times more likely to report problems in activities involving visual search, peripheral vision, and cluttered visual scenes.⁷

How do visual changes affect daily life?

Until fairly recently, the primary approach to examining impact of age-related visual changes on everyday visual activities was through self-report questionnaires. While there have been a number of health-status inventories developed and validated for the older adult population, these instruments, by and large, have not emphasized functional problems related to vision.⁸⁻¹⁰ In one exception, Coren and Hakstian¹¹ developed a questionnaire designed to assess three visual functions (visual acuity, color vision, and binocular vision). Although not specifically designed for the older adult population, the survey was validated against actual measurements of visual function, indicating that there is some degree of agreement between laboratory measures of visual function and self-reported ability.

Another questionnaire designed to assess visual function in older age was developed by Kosnik et al.⁷ This instrument asked respondents to rate the frequency with which they experienced difficulty performing 18 different visual tasks such as reading, recognizing objects, picking out a face in a crowd, seeing in dimly lit environments, and seeing moving objects. In using this instrument it was found that older adults reported significantly more difficulty with five types of tasks: processing visual information quickly, light sensitivity, dynamic vision, near vision, and visual search.^{7,12-13} A major conclusion from this work was that older individuals typically report a number of visual difficulties that would not be detected by standard clinical measures.

While the development of this questionnaire was ground-breaking, in that it recognized the importance of measuring functional vision problems from the older adult's perspective, the questionnaire was never validated against actual measures of visual function. We have subsequently developed a validated questionnaire¹⁴ based on eight underlying visual functions (color vision, glare sensitivity, light adaptation, near vision, depth, peripheral vision, visual search, and speed of visual processing). Three findings are noteworthy with respect to this study: First, most types of self-reported difficulties (e.g., near vision), were correlated with several aspects of visual function. This is not really surprising since the activities addressed in the questions represent complex visual tasks that rely on many different aspects of visual function. Second, although correlated with several visual functions, the highest correlations between self-report and lab measures typically occurred with a visual function test that measured a key aspect of the activity in question. For example, self-

reported color vision problems correlated most highly with color discrimination ability. Third, the correlations between questionnaire responses and visual measures were fairly low. While there are a host of plausible explanations for this finding (e.g., social desirability, expectations about what is normal for their age), a key conclusion from these studies is that older adults are unaware of many of the visual problems they are actually experiencing.

Thus, there are two primary lessons to be learned from questionnaire research: 1) older adults report visual difficulties that are not adequately identified by standard clinical measures, and 2) older individuals are sometimes totally unaware of their visual problems. Consistent with these conclusions, several other studies have shown a mismatch between self-reported abilities and functional measures. For example, Flint, Smith, and Rossi¹⁵ found no correlation between the amount of self-reported driving by the elderly and their performance on a driving simulation, and no correlation between performance on a vision test and their self-assessed quality of vision. Others have also found that many elderly drivers with poor vision are unaware of their problem and continue to drive with reduced vision.¹⁶⁻¹⁹

Establishing links between visual function measures and everyday performance

Several studies have attempted to establish the degree of relationship between visual function measures, such as acuity or contrast sensitivity, and tasks such as face perception which are more representative of everyday life.²⁰⁻²¹ In general, these studies have shown that for older adults, acuity is not highly related to the perception of real world targets. This is most likely due to the fact that acuity, as typically measured in the laboratory, is assessed under optimal conditions (high contrast, high illumination, isolated static targets, no competing demands on vision or attention, certainty about where the target is located), while everyday vision is conducted under conditions of varying illumination and contrast, with complex dynamic visual scenes. In addition, viewing time may be limited and in many situations, the perceiver has considerable uncertainty about what exactly to look for.

Similarly, with respect to visual field measurements, the age-associated declines in either visual field extent or luminance sensitivity throughout the field²²⁻²⁴ do not adequately predict the degree of difficulty that these older adults report with everyday activities such as driving, mobility, visual search, and the slowing of visual processing.²⁵ This is probably due to the fact that clinical perimetry measures the detection of a luminance target presented in isolation, whereas everyday

activities, such as driving, require responses such as localization or identification of suprathreshold targets in cluttered visual scenes, as well as the simultaneous use of both foveal and peripheral vision.

One everyday activity that has been extensively studied with respect to visual function is driving. Driving is probably one of the most visually complex activities that is routinely performed by older adults. A significant number of studies have been carried out in an attempt to determine whether loss of visual function is the reason for a rise in crash involvement with increasing age. This research, however, has largely failed to establish a strong link between vision and driving in the elderly. For example, several large sample studies^{19,26,27} have found statistically significant correlations between crashes and various vision tests (e.g., static acuity, dynamic acuity, disability glare), but these correlations are so low (accounting for less than 5 percent of the variance) that they are not useful in identifying at-risk older drivers.

Nevertheless, the types of crashes in which older drivers are over-represented seem to implicate visual difficulties. For example, the crash profile of the older driver (i.e., failures to heed signs, to yield the right of way, to turn safely, and more frequent junction crashes) indicates that they are having difficulty processing information from the periphery.²⁸⁻³⁰ Even so, in most studies no link has been found between age-related visual field loss, as measured by standards techniques, and driving performance.^{19,31-32} Johnson and Keltner¹⁸ reported in a large sample study that the small subset of drivers with severe visual field loss in both eyes (196 drivers out of the 10,000 studied) had crash and conviction rates twice those in the general population. Since these drivers were primarily older adults, this study documents a relationship between impaired visual function and driving in the elderly. However, no study to date has established a link between driving and less severe types of visual field loss more typical of the elderly. In addition, this issue may be somewhat complicated by the use of compensatory strategies, such as avoidance of difficult driving situations. The use of such strategies would obviously obscure any relationship between severe visual dysfunction and driving behaviors or crashes.

Since older drivers represent the most rapidly growing segment of the driving population, in both total number of drivers on the road, and the number of miles driven annually per driver,³³ there is considerable concern about how to evaluate their driving ability, and how to ensure their safety on the road without jeopardizing their mobility. The failure to find a strong link between visual deficits and driving in previous work is not a simple issue. Visual function at some level obviously plays a large role in an individual's ability to

drive. However, since previous studies relied almost exclusively on visual sensory tests to predict driving performance, ignoring higher-order visual function, it could be that more complex visual tasks would produce better results. Sensory tests, such as visual acuity and peripheral field sensitivity, although quite appropriate for the clinical diagnosis and assessment of ocular disease and vision loss, do not by themselves reflect the visual complexity of the driving task, and therefore would not be expected to reveal a strong relationship between vision and driving. The visual demands of driving are quite intricate. Navigating a vehicle takes place in a visually cluttered environment and involves the simultaneous use of central and peripheral vision and the execution of both primary and secondary visual tasks. The driver is usually uncertain as to when and where an important visual event will occur. Visual sensory tests do not typically incorporate these stimulus and task features, but instead seek to minimize perceptual/cognitive influences. Thus, in designing a visual test to predict driving problems, it would be advantageous to incorporate stimulus and task characteristics that more accurately reflect the visual demands of driving.

Before describing the development of a new method for assessing functional vision as it relates to driving, it is instructive to know what visual functions are needed for safe driving. A recent publication of the California Department of Motor Vehicles³⁴ attempted to answer this question.

"Safe driving requires the driver to continually search for information relevant to driving. This kind of information includes road signs, appearance of hazards, and changes in the flow of traffic. Continual searching in driving is mostly done with our eyes (and brain) and is in large part carried out automatically and without conscious awareness. Periodically, during this continual searching, the driver's attention will be directed to locations in space where there is driving-relevant information. Once the driver is alerted and consciously notices, this driving-relevant information is processed so as to discern detail, identify, and/or recognize what the driver is looking at. Detecting relevant information depends on the size of the driver's 'window of attention' - the size of the visual field in which useful information can be acquired in a single glance. Imagine looking over your steering wheel at a busy intersection. While looking straight ahead, your window of attention will be outlined by the circle encompassing the area in which you will notice important events. The size of this circle depends on the driving situation and you, the driver. For example, the more a driver has to focus on dealing with some aspect of the driving task, such as avoiding rear-ending a suddenly braking car, the smaller the circle (that is, the smaller the driver's window of attention). The smaller the size of the

window of attention, the less likely a driver is to notice other relevant information, such as the car in the next lane drifting into the driver's lane. The size of a driver's window of attention may also be diminished if the driver has suffered a sensory loss and perhaps cannot detect objects in one or more portions of the field of view. Such losses may occur with glaucoma, retinal disorders, cataracts, and normal aging.⁴³⁴

Developing new methods for assessing functional vision

The new method we will describe for measuring this window of visual attention is based on our own work with what we have termed the "Useful Field of View" (UFOV). Vision scientists have long been referring to the "functional," "effective," or "working" visual field, and this has been defined as the spatial area or visual field extent that is needed for a specific visual task.³⁵ Measures of this field are very different from clinical measures of visual field size, and can be very much smaller than the area of visual sensitivity per se. The UFOV is measured binocularly, and involves detection, localization, and identification of suprathreshold targets in complex displays. The limits of this field can vary substantially from one person to the next, and under varying task demands. For example, the diameter of this field is related directly to both target/distractor similarity as well as stimulus duration.³⁶ That is, more conspicuous targets can be attended at further eccentricities than less conspicuous targets, given a constant duration, and targets presented for a longer time can be attended at further eccentricities given a constant level of conspicuity.

In an initial study, Sekuler and Ball³⁷ designed a task that measured how well a single, randomly positioned target could be localized in the presence of distractors, both with and without a secondary center task. It was found that age differences were greatest at increased retinal eccentricities, indicating a restricted UFOV for older adults relative to the young. Performance on this task was found subsequently to be predictive of the frequency with which older individuals reported difficulty with everyday activities involving their peripheral vision.²⁵ In more recent work, we examined the possible roles of three attentional deficits as components for age-related reduction in the UFOV: 1) reduced speed of visual processing (reflected by an inability to localize peripheral targets at stimulus durations where such ability was present in younger individuals), 2) reduced ability to divide attention (reflected by an inability to localize peripheral targets whenever increasing demands were placed on foveal vision), and 3) reduced selective attention (reflected by an inability to localize targets in an embedded condition

Table 1: Average UFOV reduction for groups of individuals with specific attentional deficits

Type of deficit	Percent reduction relative to normal
1. Divided attention	28
2. Selective attention (distractor)	46
3. Slowing of processing	54
4. Both 1 and 2	61
5. Both 1 and 3	73
6. Both 2 and 3	79
7. All 3 deficits	85

relative to localization performance for targets presented in isolation). In one study³⁸ we assessed the prevalence of each of these three possible deficits in a group of older individuals. We found that even though the deficits became more common with advancing age, that many of the older individuals did not experience any difficulties at all.

In order to study how these three deficits interacted in reducing the UFOV on an individual basis, we sorted our 86 participants into eight groups: 1) those with no visual attentional deficits, 2) those with reduced speed of visual processing, 3) those with reduced ability to divide attention, 4) those with reduced selective attention, 5) those with both reduced speed and divided attention, 6) those with both reduced speed and selective attention, 7) those with both reduced divided and selective attention, and 8) those with reductions in all three areas. Table 1 illustrates the average reduction in the size of the UFOV based on these groups of individuals, relative to a group experiencing no reductions. Note that the effects of multiple deficits, when they occur, are additive such that an individual with all three deficits, on average, has a loss of 85 percent of the field relative to the normal group.

UFOV and everyday vision

As discussed previously, survey results have indicated that the frequency of difficulty that older adults report on everyday tasks associated with visual search, peripheral vision, and cluttered visual scenes is much higher than for younger individuals. We have previously suggested that a constricted UFOV may be responsible for these reports.³⁷⁻³⁸ Even though individuals have unlimited viewing time in many daily situations, a constricted UFOV could affect performance by forcing the observer to perform more fixations in order to scan the same visual area. With respect to the earlier Department of Motor Vehicle's statement concerning what is needed for safe driving, the UFOV measures the window of attention within which an individual can be rapidly alerted to visual stimuli. When driving, if a visual target

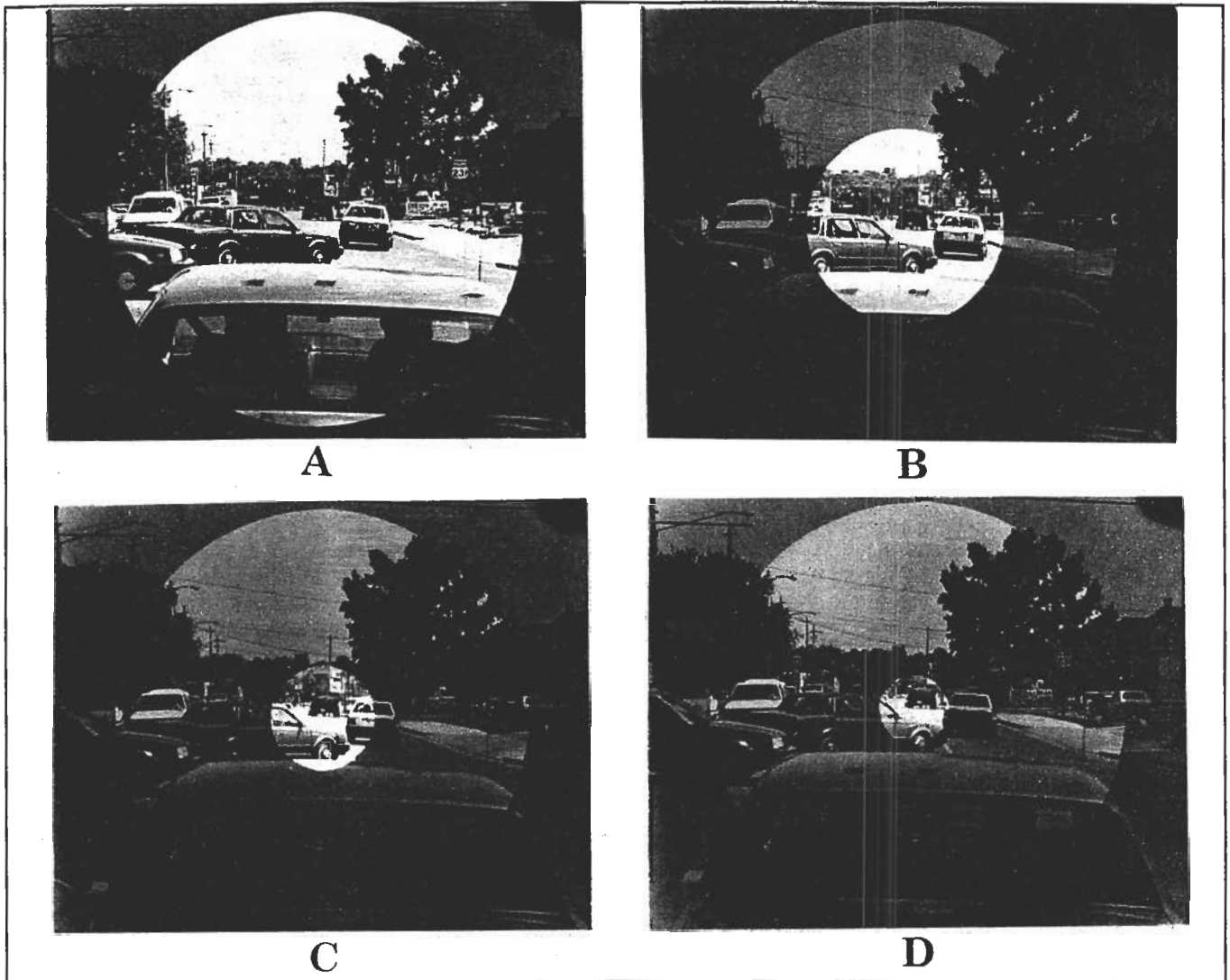


Figure 1: An illustration of how restrictions in the UFOV may increase the probability of crashes. Panel A displays the average size of the “attentional window” for those individuals with no restriction of the Useful Field of View. Panel B displays this window for those individuals who have experienced a significant decline in the speed of visual information processing. Panel C displays this window for those individuals who have experienced both a slowing and an extreme sensitivity to distraction. Finally, the most extreme cases of UFOV restriction is illustrated in Panel D for those individuals who have experienced slowing, sensitivity to distraction, and the inability to divide their attention between central and peripheral tasks. Note that the areas depicted in this figure do not represent the size of the visual field, but are scaled to represent relative reductions in the size of the UFOV for different groups of individuals.

appears and is salient enough to attract attention, a driver will naturally slow down and turn his/her head or eyes to acquire additional visual information. If a hazardous stimulus does not attract attention, and therefore it is not identified in time, the driver is more likely to have a crash.

Figure 1 illustrates how restrictions in the UFOV may increase the probability of crashes. It should be noted that the areas depicted in this figure do not represent the size of the visual field, but are scaled to represent relative reductions in the size of the UFOV for different groups of individuals. Panel A of Figure 1

displays the average size of the “attentional window” for those individuals with no restriction of the Useful Field of View. Individuals who have experienced a significant decline in the speed of processing visual information will average a UFOV reduction of approximately 50 percent, as shown in Panel B. Individuals who have both a slowing and an extreme sensitivity to distraction have an even larger UFOV reduction, as shown in Panel C. Finally, the most extreme cases of UFOV restriction are those in which individuals have experienced slowing, sensitivity to distraction, and the inability to divide their attention between central and peripheral tasks.

These drivers, illustrated in Panel D, are able to process only a fraction of the information available to the drivers illustrated in Panel A.

While most younger drivers have an unrestricted UFOV, as represented in Panel A, some may experience one or more of these restrictions. Similarly, while the prevalence of drivers with UFOV restriction rises with age, there remains a significant number of drivers over 80 years of age with an unrestricted UFOV, as in Panel A. Thus UFOV restriction is independent of chronological age, except when viewed as an increased prevalence. Additionally, even an individual with normal functional vision (e.g., acuity, contrast sensitivity, visual field sensitivity) may have a restricted UFOV. Thus UFOV restriction may also be independent of visual sensory function.

Recently we have tested our hypotheses concerning UFOV reduction and driving in a series of studies designed to evaluate the roles of vision and visual attention in crash prediction. We assessed several different aspects of vision and visual processing, including eye health status, visual sensory function, visual attention, cognitive status, and also obtained information about each subject's driving habits. The visual sensory function tests have been described in detail elsewhere^{39,40} and consisted of visual acuity, contrast sensitivity, disability glare, stereopsis, color discrimination, and visual field sensitivity using an automated perimeter. These tests were chosen because they represent major aspects of visual sensory function and have good test-retest reliability. Mental status was assessed by the Mattis Organic Mental Status Syndrome Examination, specifically designed to assess cognitive status in the elderly. This test provides a composite score of cognitive function that reflects performance in several categories such as abstraction, digit span, verbal and visual memory, and block design.

Visual attention was assessed using the Visual Attention Analyzer. This instrument, illustrated in Figure 2, uses three subjects to provide a reliable measure of UFOV size, expressed in terms of the percentage reduction (0-90 percent) of a maximum 35 degree radius field. The details of this procedure have been described in detail elsewhere.^{39,40} In the first subtest, which is designed to assess speed of visual processing, the subject is required to identify a target presented at fixation, which varies in duration. This target is the silhouette of a car or a truck. In the second subtest, which is designed to assess the ability to divide attention, the subject is also required to identify the central target, and in addition to localize a simultaneously presented peripheral target that can be located at various eccentricities (10, 20, 30 degrees). Here again, the duration of the display is varied to measure speed of visual processing for this divided attention task. In the third

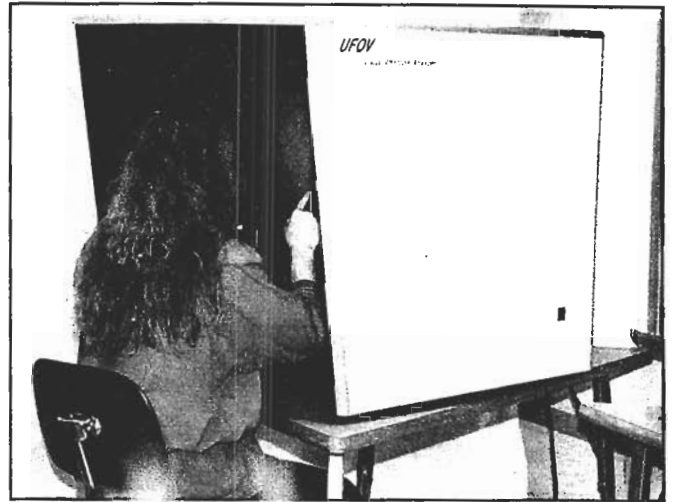


Figure 2: Visual Attention Analyzer as used to measure the Useful Field of View.

subtest, which is designed to assess selective attention abilities, the subject is required to make these same two responses (also at different stimulus durations), however the peripheral target is embedded in distractors (triangles). This subtest provides another measure of speed of processing while distracting stimuli are present. These subtests are presented on a large video monitor (20 in. diagonal) at a viewing distance of 23.5 cm. Performance in the subtests is combined to arrive at three scores representing the extent of difficulty with respect to speed of processing, divided attention, and selective attention. These scores range from 0 (no problem) to 30 (great difficulty). Since deficits in each of these abilities have previously been shown to be both independent and additive in their effect on the size of the UFOV, the three scores are summed to yield a score between 0 and 90, which represents the percentage reduction of a maximum 35 degree radius field.

The goal of this research program was to evaluate the roles of several visual and cognitive measures in predicting crash frequency in older drivers. Results indicate that although eye health was predictive of visual function, neither eye health nor visual function were significantly related to crash frequency data obtained from state records. Furthermore, we also found that visual function was moderately predictive of the size of the UFOV, thus supporting our theory that tests of visual attention would be determined in part by the quality of visual sensory input. Finally, we found that both the UFOV measure and the mental status score were each significantly related to crash frequency. These two measures also were significantly related to each other, and jointly accounted for 20 percent of the crash variance.

Further analysis of crash type

Because intersections in particular require an awareness of peripheral vehicles and objects, we hypothesized that the UFOV should be more highly related to intersection crashes than to crashes in general. Indeed, we found that most of the crashes in our sample occurred at intersections, and that the additional crashes on record were primarily not the fault of our research participant (e.g., they were hit from the rear while stopped in traffic). We therefore conducted further analysis, limited to only the intersection crashes, and found that the predictions of the UFOV test and mental status became even better. Each of these significant predictors was then examined in more detail.

A breakdown of crashes by mental status showed that the eight subjects with poor mental status scores had a total of nine crashes compared to seven such crashes among the other forty-five participants. Thus, per subject, those with poor mental status were 6.3 times more likely to have an intersection crash than those with good mental status. The top half of Table 2 illustrates the ability of the mental status measure to correctly sort individuals into those predicted to have crashes and those predicted to have no crashes. Of the 34 individuals who were predicted to have no crashes, nine had at least one crash. On the other hand, of the 19 individuals who were predicted to have one or more crashes, 11 had no crashes. Thus the mental status score resulted in 20 errors in prediction (nine misses and 11 false alarms) among the 53 participants.

With respect to the UFOV, those subjects who failed were responsible for all but one of the intersection crashes. In this case, the 26 individuals who failed the UFOV had 15.6 times more intersection crashes on average than those who passed. The bottom half of Table 2 illustrates the ability of the UFOV measure to predict crashes. Based on this test 26 of the 27 individuals who were predicted to have no crashes had no crashes. On the other hand, of the 25 individuals who were predicted to have a crash, 14 did not. Thus for the UFOV there were 15 errors in prediction (one miss and 14 false alarms).

There are several potential reasons for these findings. One possibility is that these drivers somehow modified or self-regulated their driving, as described earlier, in response to either visual problems, near-misses, or crashes themselves. Of the 14 individuals in this sample who failed the UFOV test and had no crashes, 10 of them had poor eye health. Furthermore, an examination of the responses of our participants to the driving habits questionnaire revealed that those individuals with significant eye health problems (in particular, cataracts or severe visual field loss) reported more frequent avoidance of challenging driving situations (night driving, driving on high-traffic roads, driv-

Table 2: Crashes predicted by mental status and UFOV

	Predictions Made by MOMSSE	
	0 crashes on record	>0 crashes on record
Predicted 0	25	9
	Correct rejections	Misses
Predicted >0	11	8
	False alarms	Hits
	Predictions Made by UFOV	
	0 crashes on record	>0 crashes on record
Predicted 0	26	1
	Correct rejections	Miss
Predicted >0	14	11
	False alarms	Hits

ing during rush hour traffic) than those who did not have these ocular health problems. Those with significant visual function deficits, attentional deficits, and mental status deficits, did not report any modification of their driving behavior. Although eye health itself was not associated with a higher crash rate, this may be partly due to the fact that these individuals had been made aware of their eye health problems, and therefore voluntarily restricted their driving activity. These individuals were over-represented in the group of people who were predicted to be crash involved by the UFOV test. It is also interesting to note of those who failed the UFOV test and had crashes, that about half had poor eye health and half did not. It might be hypothesized that those individuals with good eye health and poor UFOV or mental status would constitute the highest risk group of drivers, if indeed poor eye health results in driving avoidance. While it is not possible to determine whether those with poor eye health might have had even worse records had they not avoided driving, it is certainly the case that among those drivers with crashes, those with poor UFOV and good eye health are experiencing approximately the same degree of crash involvement as those with poor UFOV and poor eye health. Therefore, it is possible that simply informing an older driver with a significant visual attention deficit (as assessed by the UFOV task) that they have such a problem, might in itself contribute to his/her avoidance of especially difficult driving situations, and also might possibly reduce crashes.

One final aspect of our results needs emphasis - the relationship between sensory tests of visual function and UFOV. Of all the visual function measures evaluated, the relationship between peripheral visual field sensitivity loss, as assessed with the Humphrey Visual Field Analyzer, and the UFOV was the strongest ($r = 0.48$). Those drivers with peripheral sensitivity loss in

our sample had approximately twice as many crashes as those with normal visual field sensitivity, consistent with Johnson and Keltner's work.¹⁸ However, excellent sensitivity in the visual field alone was not a sufficient condition for a normal useful field of view. Approximately 50 percent of our subjects had normal visual fields, yet failed the UFOV test. Since loss of awareness of peripheral stimuli can occur in several ways (e.g., visual field loss, attentional loss), it is not surprising that the UFOV, a test that is sensitive to both visual field loss and attentional loss, was a better predictor of crashes than visual field sensitivity alone.

Another question is whether the model prediction could be improved or incremented by adding additional predictors (other attentional measures, measures of risk taking behavior, other biomedical variables). At least in the current sample, it appears that the inclusion of additional predictors could not enhance the overall sensitivity of the measure (already 92 percent). The area in which the model may be adjusted to improve prediction is in terms of specificity (identifying which drivers will not be involved in a crash). This group currently consists of two populations: those individuals with excellent visual function, UFOV and mental status, and those with poor performance on all predictors, but who have modified their driving habits to avoid crash involvement. Additional information on driving behaviors and avoidance may therefore improve the specificity of our model in terms of identifying those individuals whose driving behavior is inconsistent with their predicted performance.

Using valid predictors to improve safety and mobility

As pointed out earlier, self-regulation has had limited success given that older drivers as a group remain over-represented in crashes per mile driven. Our data suggest that this may be due, in part, to the fact that self-regulation occurs in response to diagnosis of eye disease, and that since drivers are unaware of their attentional limitations no regulation would occur. Thus simply informing those older drivers experiencing significant visual and/or attentional deficits may at least modestly aid in changing their driving behaviors and strategies.

Given that this is true, the issue then becomes who will provide the testing? It is unlikely that tests such as the UFOV can be administered quickly enough to retain their reliability and be useful as a general screening technique in a DMV setting. These tests would be more appropriately administered in a health care setting by trained personnel. Thus instead of adding additional tests during driver licensing, one approach would be for eye care specialists to provide a "certificate

of good vision" for older adults to present to the DMV licensing office. Eligibility for the certificate could be based on some criterion level of performance on a battery of visual tests, including a test of visual attention such as the useful field of view test. Most older individuals already visit an eye care specialist on a regular basis, so the rudiments of this mechanism may already be in place. Certified personnel, such as optometrists, could supervise the administration of both visual and attentional tests, counsel the elderly driver with respect to any potential limitations based on the results of these tests, as well as provide professional help with respect to any eye health issues.

Expanding the UFOV

Even though many older individuals experience a restriction in the UFOV, much of this loss can be reversed with training. Improvements have been demonstrated from 60-300 percent with training programs of only 30 mins per day over a 5-day period of time. Studies have shown that improvement is retained for 6 months to 1 year without further training.³⁸ Furthermore, training has been found to be effective for adults of all ages. Future research must determine whether expanding the UFOV actually results in a reduction in crash involvements over a given period of time.

Summary

As primary vision care providers, optometrists will be asked to care for increasing numbers of older adults during the next few decades. This demand will be especially great due to extended life expectancy, and recent public policy decisions providing Medicare coverage for optometric services. It is clear that current clinical tests do not adequately address at least one important area of visual processing, visual attention, which will become impaired in some older adults and which is predictive of real-world problems. Given that visual attention is known to be related to mobility problems in the elderly, the development and use of new tools, such as the UFOV test, will improve the ability of eye care specialists to evaluate, treat and counsel their older patients. ■

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