

Distracted Driving and the Need for Comprehensive Optometric Eye Exams

Between 2010 and 2018, highway fatalities rose by 9.7%.ⁱ Drivers are often distracted by passengers, navigation systems, smartphones and driver assistance systems.ⁱⁱ Distracted driving is dangerous, claiming 2,841 lives in 2018 alone. Among those killed: 1,730 drivers, 605 passengers, 400 pedestrians and 77 bicyclists.ⁱⁱⁱ

Driving is a complex task, requiring a large range of visual, psychomotor and cognitive abilities.^{iv} Importantly vision perception occurs in the brain and not within the eyes, thus it is cognition and not simply vision that matters most. Even with 20/20 visual acuity in each eye, small defects in motor skills and visual processing can cause cognitive delay which can become fatal in highway driving. While phones and automobiles have become “smarter” since 2010, human visual skills and visual cognitive abilities have not kept pace.

For example, studies show that texting messages while driving worsens driving performance for all age groups. This task, requiring the driver to look away from the road, was found to reduce performance due to the driver attempting to monitor the road ahead using peripheral vision.^v Peripheral vision to monitor the road has two important drawbacks: 1) it relies on areas of the retina with low sensitivity to color and detail and 2) the images at a distance are double when focusing on a cell phone or other device at near.^{vi}

Research to better understand reaction times of drivers to a traffic event originating in their peripheral vision while simply engaged in a mobile phone conversation, apart from texting, show that reaction times are 40% longer in this distracted condition as compared to baseline (not distracted).^{vii} Other studies show that reductions in the ability of the vision system to recognize a spatial pattern of varying size, spaced and boldness of lines may be a predictor of crash risk. This type of deficit added to a visual acuity deficit lengthened reaction time and the distance required to stop before the collision point.^{viii}

Night driving adds distraction primarily from uncorrected or under-corrected astigmatism where there is more than one focal length in the eye causing persistent and often aggravating glare and halos around headlights and taillights from other vehicles and distortion in viewing road signs. Drivers may not be aware of the causal link between astigmatism and these problems, and thus may not realize that vision correction may reduce such distraction. Studies show that the correction of even low to moderate levels of astigmatism had significant positive effects on night-time driving performance.^{ix} Many ocular diseases also cause increased disorientation and vision difficulties at night. These range from cataracts to corneal surface disorders and retinal disorders to ocular neuropathic disorders such as corneal dystrophies and extraocular muscle palsies, all of which may cause persistent or intermittent double vision or field loss.

Keeping one’s eyes on the highway is in fact a lot like keeping one’s eyes on the ball. Assessments for individual performance in both areas (*i.e. batting and driving*) require vision tests apart from acuity

testing. Vision problems apart from acuity can affect balance and performance. Neurologic events such as traumatic brain injuries (TBI), cerebrovascular accidents (CVA), and chronic neurological conditions including Parkinson's disease, multiple sclerosis, and cerebral palsy can directly affect posture, balance and spatial orientation. A comprehensive battery of optometric testing and a well-developed therapeutic plan can be used to enhance visual skills such as peripheral vision, sharpness of eyesight, speed of recognition, focus flexibility, visual concentration, visual anticipation and visual midline appreciation.

All U.S. states have a threshold for visual acuity for drivers (e.g. most use 20/40 for an unrestricted license). The following vision disorders can lead to increased distracted driving but are not evaluated by visual acuity testing at motor vehicle licensing facilities and therefore require in-person comprehensive eye examination by an eye doctor:

- 1. Refractive Error Problems**-Under corrected or uncorrected farsightedness (hyperopia) and astigmatism (image distorted at all distances especially distracting at night) may cause tiredness, confusion and reduced reaction time while driving, which will be exacerbated by distracted driving.
- 2. Binocular Vision Dysfunction**-When the two eyes are not properly aligned, the inputs from the two eyes are not successfully combined in the brain causing a loss of depth perception. This may result in misjudgments and miscalculations in determining distances, especially in tight spaces and in heavy traffic. Considering that distracted drivers over rely on peripheral vision, the depth perception is even worse.
- 3. Eye Coordination Difficulties**-Difficulty in maintaining eye alignment can result in seeing double and in eye fatigue. Eye fatigue can quickly result in general fatigue and reduced awareness of one's surrounding which will be amplified when drivers are distracted.
- 4. Eye Focusing (Accommodation)**-Deficiencies in the ability to precisely change focus from distance to near can cause intermittent distortion, blur and headaches. This is especially troubling while driving as frequent changes in viewing instrument readouts and controls and the road cause visual difficulties that result in fatigue know as asthenopia. Looking at a phone makes these concerns significantly worse.
- 5. Contrast Sensitivity**-Measures the visibility and recognizability of a spatial pattern of varying sized, spaced and boldness of lines and is therefore a more comprehensive assessment of visual function than acuity, which only determines the smallest resolvable letter size. These measurements of contrast sensitivity also better relate to visual performance in glare situations commonly encountered while driving. Distracted drivers experiencing glare will have even less awareness and longer reaction times.
- 6. Visual Processing Dysfunction**-Rapid motion effects, especially in the periphery, can cause vision-induced sensations of movement that disagree with the vestibular or balance system causing dizziness, reduced attention-processing speed, and inappropriate perception of visual midline that may misinform driving information. Problems with visual midline shift, posture and balance as part of visual processing can cause disorientation while driving, as we actually see with our brain not just our eyes. Distracted drivers are using their brains for non-driving activities, further hampering the ability of the brain to process visual information quickly.
- 7. Color Vision Disorders**-Substantially more common among men, certain color vision disorders have a significantly lower than normal sensitivity to red light. Individuals will have a reduced visual range for red traffic signals, tail lights and brake lights and may also fail to see lower-intensity red

retro-reflectors that mark out an otherwise unlit parked vehicle. Distracted drivers are more likely to miss these visual cues as a result.

8. **Age Related Eye Diseases**-Macular degeneration (often called age-related macular degeneration (AMD), Cataract, Diabetic Retinopathy and Glaucoma cause vision loss. For example, studies found that impaired visual field among individuals with glaucoma was independently associated with at fault motor vehicle accidents. While some states have added a horizontal (side to side) field of view test to their screening battery, more contemporary studies point to inferior and superior (up and down) not horizontal field loss as the predominant factor to determine risk of motor vehicle accidents. Additionally, central fields assessed during comprehensive eye examination are critical for viewing instruments and using rear and side view mirrors. Examination for cataracts is important as these can cause glare and color vision distortion, especially in low light environments where driving with headlights is necessary.^{x xi}

Importantly, many of these common vision conditions are asymptomatic but can substantially exacerbate the risks of distracted driving. Identifying these conditions and treating them is a public health imperative toward a shared goal of overall reductions in distracted driving. While vision screenings are sometimes required by state departments of motor vehicles in issuing driver's licenses, these screenings in no way adequately assess an individual's visual performance. Take care of your vision and have a periodic, thorough comprehensive eye examination. And take the National Highway Safety Institute's pledge to end distracted driving: <https://www.nhtsa.gov/risky-driving/distracted-driving#16991>

ⁱ <https://www.fhwa.dot.gov/policyinformation/statistics/2018/pdf/fi210.pdf>

ⁱⁱ Wolf B, et. al., Detection of Brake Lights while distracted: Separating peripheral vision from cognitive load, *Atten Percept Psychophys*. 2019 Nov; 81 (8): 2798-2813

ⁱⁱⁱ <https://www.nhtsa.gov/risky-driving/distracted-driving#16991>

^{iv} Dukic WT et. al. Driving Characteristics of Older Drivers and Their Relationship to the Useful Field of View Test. *Gerontology*. 2017; 63(2): 180-188

^v Wolf B, et. al., Detection of Brake Lights while distracted: Separating peripheral vision from cognitive load, *Atten Percept Psychophys*. 2019 Nov; 81 (8): 2798-2813

^{vi} <https://www.youtube.com/watch?v=EGICVTdNqfw>

^{vii} Ortiz C et. al. Driving simulator; Mobile phone distraction; Parametric duration model, *Accid Anal Prev*. 2018 Aug; 117: 239-249.

^{viii} Swan G. et. al. The effects of simulated acuity and contrast sensitivity impairments on detection of pedestrian hazards in a driving simulator. *Transp Res Part F Traffic Psychol Behavior*. 2019 Jul; 64: 213-226.

^{ix} Black A, et. al. The impact of uncorrected astigmatism on night driving performance. *Ophthalmic Physiol Opt*. 2019 Sep; 39 (5): 350-357.

^x Kunimatsu-Sanuki, S, et. al. The role of specific visual subfields in collisions with oncoming cars during simulated driving in patients with advanced glaucoma. *Br J Ophthalmol* 2017;101:896-901

^{xi} <https://www.healio.com/optometry/glaucoma/news/online/%7B55f3b355-8241-4cf1-8af8-b2f2db8b60de%7D/glaucoma-linked-to-altered-driving-behaviors>