



# Safe Driving for Individuals with Low Vision and Brain Injury

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## Objectives

- Define the clinical term low vision.
- Identify common diagnoses that limit driving performance for individuals with low vision.
- Describe how driving performance is impacted by visual deficits.
- Describe the role of the general practitioner in safe return to driving.
- Describe the role of the low vision specialist in safe return to driving.
- Understand the use of bioptic telescopes for driving.

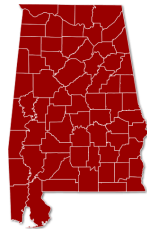
## Roadway Statistics

Over 102,000 miles of public roads in Alabama

- Ranked 18<sup>th</sup> in nation
  - 75% Rural roads
  - 26% Urban roads

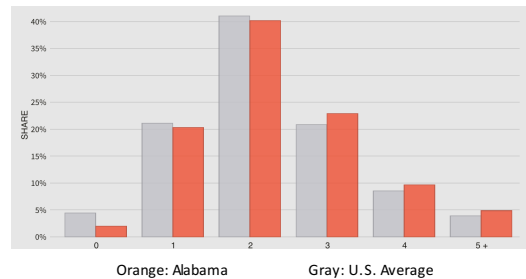
67,000 miles driven, ~ 2% bus mileage

2015 U.S. Department of Transportation



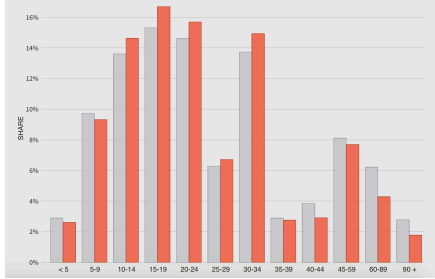
## Roadway Statistics

Average # of cars per household: Alabama

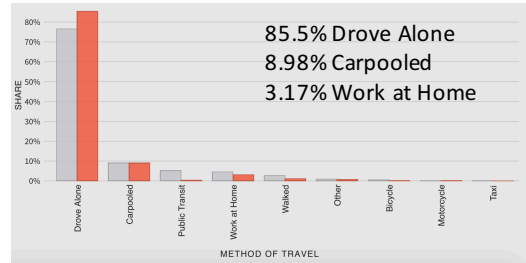


## Roadway Statistics

Average Commute Time: 23.8 minutes



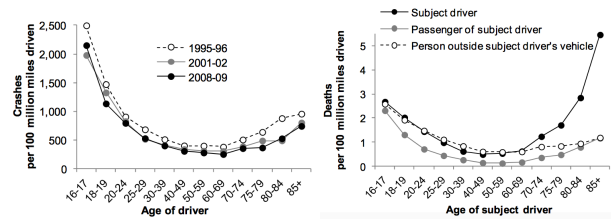
## Roadway Statistics



## Roadway Summary

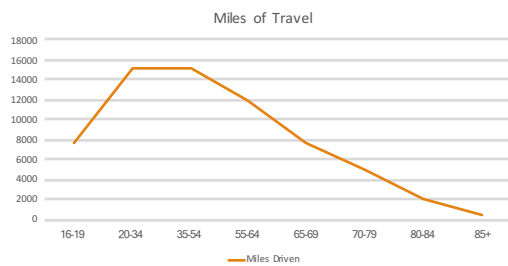
- On average, Alabamians have an approximate 25-minute commute to work/school.
- Nearly 90% of Alabamians drive alone
- Majority of Alabamians do not have reliable access to public transportation.

## Crash Rate by Age



AAAFoundation.org

## Total Miles Travelled



## Aging and Driving

- While these numbers do not account for individual variables (such as disabilities), we do see a trend in driving performance and age.
- Drivers 18 and below most likely to be involved in a crash.
- Risk begins to increase again after age 70
- Some, but not all older drivers experience changes that effect their ability to drive.

## Risk Factors for Older Adults

- Vision-related changes
  - Cataract, AMD, Glaucoma
- Cognitive changes
  - Depression, dementia
- Physical condition
  - Increased incidence of diabetes, stroke, heart disease, arthritis,
- Medications
  - Antidepressants, blood pressure, benzodiazepines

## Vision and Driving

Estimated that 90% of input a driver receives is visual<sup>1</sup>

- Visual input is used to guide cognitive and motor responses
- Safe driving depends on a person's ability to sense the environment, analyze and respond to sensory stimuli in a timely manner.



## Vision and Driving

Vision testing is required to obtain, and in many cases, renew a driver's license.

- All states have visual acuity requirements for driving
- Vision requirements differ for each state.



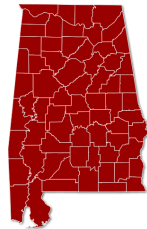
## State Requirements

### Vision

- Visual acuity – Best corrected acuity of at least 20/60
- Visual field - 110 degrees (horizontal)

### Physical

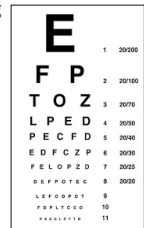
- Seizures
- Neurological conditions



## Vision Terms

Visual Acuity – clarity or sharpness of vision

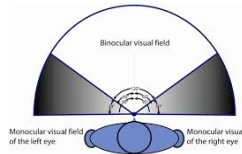
- Enables us to see things clearly when driving
  - See and read directional signage
  - See and respond to traffic and brake lights
  - Read meters on dash
  - Clearly see objects on the road



## Vision Terms

Visual Field – what you see of the world when looking in a fixed direction

- Enables us to be aware of objects both centrally and peripherally when driving
- See and respond to merging cars
- Locate and make lane changes
- Awareness of pedestrians crossing



## Vision Terms

Contrast Sensitivity – ability to distinguish low contrast items

- Enables us to recognize objects from their background
- Enhances ability to drive in low light situations
- Recognize sidewalks and curbs from street
- Identify objects/potholes in street



## Vision and Crash Research

Visual Acuity - early research focused on acuity and crash risk.

- Correlations found between decreased acuity and compromised binocular vision (1976, 1994)
- Data since has been very ambiguous with weak associations.
- Mild acuity loss does not appear to elevate crash risk.

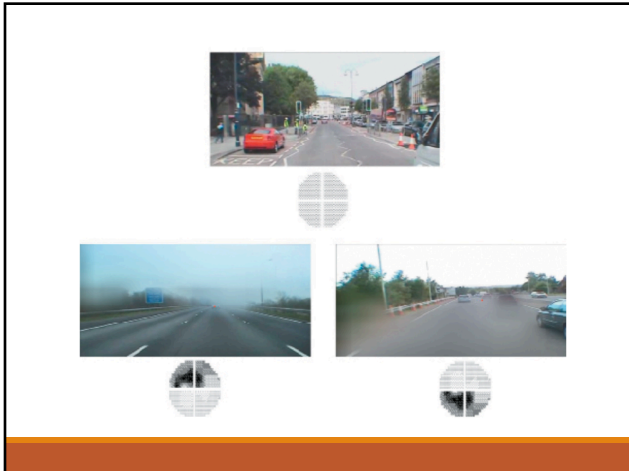
## Vision and Crash Research

Visual Field – research from the mid-2000's and on is somewhat ambiguous

- Likely due to different methodologies
- Strongest evidence from Salisbury Eye Evaluation Study
  - Field loss predictive of crash involvement, particularly loss in the inferior peripheral field

Rubin et al., 2007

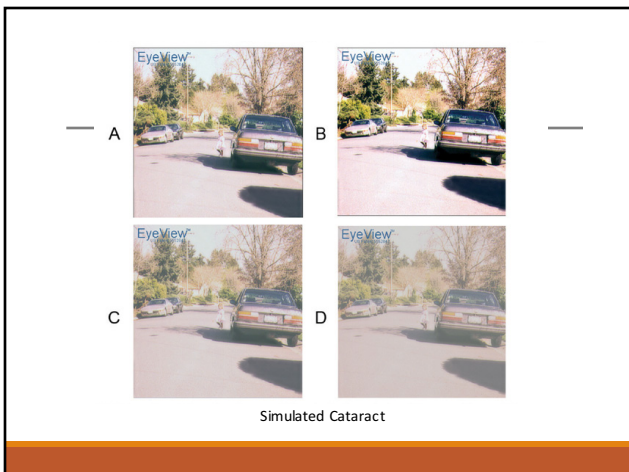




## Vision and Crash Research

Contrast Sensitivity – appears to be a better predictor of driving performance than acuity.

- Most common cause – senile cataract
- 2.5x more likely to have a crash history (Owsley, 2007)
- Correctable with surgery
- Can also be associated with eye pathology (e.g. Age-related macular degeneration)



## Safety Conclusions

- State driving requirements do not always accurately assess a person's ability to drive safely.
- Some individuals may be denied the privilege of driving, when they might possibly drive safely.

## Low Vision

Low vision is a vision loss so severe, that it cannot be fully corrected by glasses or surgery.

- Visual acuity is 20/70 or poorer in the better seeing eye



\*Means a person with 20/70 vision who is 20 feet from eye chart cannot see what a person with unimpaired (20/20) vision can see from 70 feet away

## Low Vision - Functionally

Low vision is uncorrectable vision loss that interferes with everyday activities.

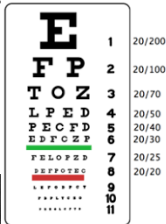
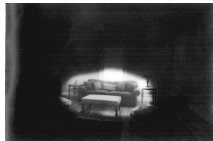
“Not enough vision to do what you need to do”

- Varies from person to person

## Low Vision vs. Legal Blindness

“Legal Blindness” – definition established by the government as a cutoff to determine disability benefits.

- Arbitrary number (20/200 or less in better seeing eye or a visual field of 20 degrees or less)



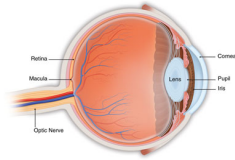
## Common Conditions Causing Low Vision in Older Adults

- Age-related macular degeneration (AMD)
- Glaucoma
- Diabetic Retinopathy
- Stroke

## AMD

Problem with the retina

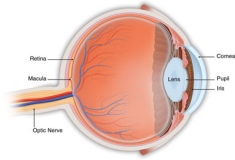
- Macula is damaged
- Lose central vision, but peripheral vision remains intact
- 2 types:  
Dry and wet (DAMD, WAMD)



## Glaucoma

Problem with the optic nerve

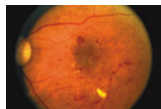
- Usually when fluid builds up in front of the eye. Puts pressure on optic nerve.
- Lose peripheral vision, but can progress to central
- "Silent thief" often goes unnoticed



## Diabetic Retinopathy

Problem with blood vessels of retina, associated with diabetes

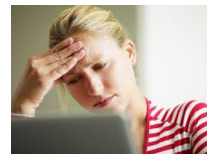
- High blood sugar causes damage to blood vessels, causing them to leak, close or grow abnormally.
- Can steal vision completely



## Stroke

Problem with visual pathways in the brain

- Symptoms depend on which part of the brain was affected.
  - Double vision
  - Light sensitivity
  - Hemianopsia

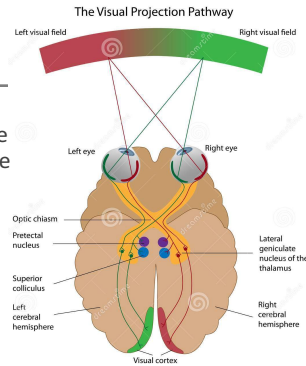




## Homonymous Hemianopsia

Visual information from the left and right fields are processed by the opposite side of the visual cortex.

- Left side stroke = right visual field loss
- Right side stroke = left visual field loss



## Homonymous Hemianopsia



Right Homonymous Hemianopsia

## Common Conditions Causing Low Vision in Young Adults

- Albinism
- Pediatric Glaucoma
- Nystagmus
- Retinal/Optic Nerve Abnormalities

## Albinism

Problem caused by lack of pigment melanin

- Results in light sensitivity
- Underdeveloped fovea (20/40 – 20/200 VA)
- Usually stabilizes in mid-teens



## Retinal/Optic Nerve

Cone Dystrophy - Degradation of cone cells in eye

- Results in difficulty seeing things that are still
- Details in daylight
- Objects in color

Rod-Cone Dystrophy – Degradation of rod and cone cells

- Gradual loss of night vision
- Loss of peripheral vision

## Occupational Therapy

Driving is an instrumental activity of daily living (IADL)

➤ OT Practice Framework: Domain and Process 3<sup>rd</sup>

➤ Driving and community mobility:

“Planning and moving around in the community and using public or private transportation, such as driving, walking, bicycling, or accessing and riding in buses, taxi cabs, or other transportation systems.”

## OT Roles

- Generalist Role
- Driver's Rehabilitation Specialist Role
- Low Vision Specialist Role

## OT Generalist

- All OTs should address driving and community mobility
- OT-DRIVE (E. Davis)
  - Evaluate sub-skills and develop intervention plan
- “...all occupational therapy practitioners who are addressing the safety risk of returning home should include driving and community mobility.”



## OT Generalist

- Refer to other team members as necessary
- Have knowledge of and develop relationships with driver rehabilitation specialists in the community
- Know when to refer for a comprehensive assessment
- Counsel on driving cessation and train on alternative transportation

## OT Generalist

### Evaluation of Sub-Skills

Should be completed as part of occupational performance assessment

- Driving history
- Accidents or near misses
- What kind of car do they drive
- Use of alternative transportation
- Self-restriction
- Where do you drive?

## OT Generalist

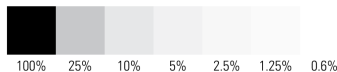
### Evaluation of Sub-Skills

Additional assessment should be completed depending on diagnosis or complaints

- Vision-related dx or decrease in functional performance that could be vision related



Lea Numbers Low Contrast Test



## OT Generalist

### Intervention Planning

- Client-centered goals that address driving sub-skills
- Consider alternative transportation
- Consider referral to low vision specialist, if appropriate
- Consider driving cessation

## Driving Cessation

- Typically a last resort
- Know state rules regarding reporting
  - Alabama may act if they perceive the person is unsafe (denying license or restricting)
  - A licensed doctor request the driver be retested or have license revoked.
- Be ready to assist in finding alternative transportation. The inability to drive can limit occupational performance.

## Driver Rehabilitation Specialist

Has specialized training beyond OT school, including certification (CDRS).

- Determine if a person is at risk or can continue to drive safely
- Completes a comprehensive driving evaluation
  - Step 1: Verify person meets state requirements
  - Step 2: Clinical evaluation
  - Step 3: On-road evaluation

## Driver Rehabilitation Specialist

### Clinic Evaluation

- Prior to on-road evaluation
- Gather medical/social history
- Determine level of pre-requisite skills
- Determine need for adaptive equipment
- Look for red flags
  - Sensory/cognitive function
- Gather information from family

## Driver Rehabilitation Specialist

### On-Road Evaluation

- Completed in instructor's vehicle
- Essential to determine functional impact of vision deficits and ability to use adaptive equipment or adaptive strategies
- Application of cognitive strategies behind the wheel:
  - Decision making
  - Route planning
  - Judgment



## Low Vision Specialist

Occupational Therapist works with client by referral (typically ophthalmologist or optometrist) to develop a plan of care that addresses client goals.

- Often assessment of performance skills for driving
- Training in the use of adaptive equipment

May or may not have specialty certification (SCLV)

## Low Vision Specialist

Clinical evaluation typically includes:

- Medical/social history
- Motor skills
- Cognitive function
- Sensory function
  - Acuity, fields, contrast, color (if not provided by referring physician)
- Functional mobility status

## Low Vision Specialist

Dynavision

- Simulates visual field
- Allows objects to be displayed in periphery to assess reaction time.
- Can include distractors to simulate divided attention tasks.
- Used to teach visual scanning



## Low Vision Specialist

Useful Field of View (UFOV)

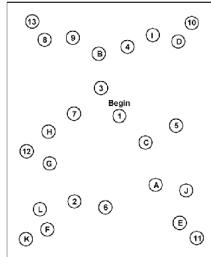
- Computer-based assessment of processing speed and attention
- Considerable research to support scores below an identified threshold increases crash risk.



## Low Vision Specialist

### Trails Making Test A & B

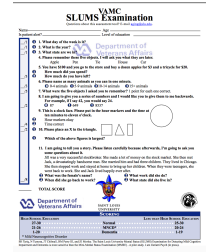
- Neuropsychological test of visual attention and task switching.
- Provides info on visual search speed, scanning, and executive function



## Low Vision Specialist

### Saint Louis University Mental Status (SLUMS)

- Brief oral/written screening tool
- For detecting mild cognitive impairment and dementia
- Memory-loss often first presents with decreased way-finding.



## Low Vision Specialist



## Low Vision Specialist

### Bioptics

- System to view objects at a distance
- Carrier lens and telescope
- Considerations
  - focusing
  - monocular vs binocular
  - field of view
  - mounting location



## Bioptics

1. Interstate signage to normal viewer
2. View through Galileian bioptic (simulated)
3. View through Keplerian bioptic (simulated)



## Steps for Bioptic Driving

1. Individual is determined by an ophthalmologist or optometrist to meet vision requirements of state
  - Alabama this must be at least 20/60 or better using bioptic
  - 110 degree field of view
2. Individual is fitted for preferred/appropriate device
  - Precise eye measurements taken by optometrist
3. Device is ordered and adjusted for proper fit when dispensed
4. Training by an occupational therapist to ensure accurate techniques and speed for spotting with device
5. Around 30 hours of on-road training with CDRS before taking driving exam

## Low Vision Specialist

- Provides sound clinical judgement on physical, sensory and cognitive appropriateness for return to driving.
- ALWAYS refer to a driving rehab specialist to assess the client functionally behind the wheel!

## When to Refer

- Client has a known diagnosis that could impact driving
- Client is having repeated accidents while driving or performing functional mobility
- Counsel client not to drive until referred for evaluation (vision doctor)
- Pre-driver screen, such as OT-DRIVE or OT-DORA

## How to Refer

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- Best practice is to refer directly to low vision doctor (ophthalmologist/optometrist)
- Can ask physician to refer directly to low vision OT with certain definitive diagnoses
  - Example - homonymous hemianopsia
- Client cannot be receiving other forms of OT concurrently for outpatient services

## Locations

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UAB Center for Low Vision  
Rehabilitation

Community Services for Vision  
Rehabilitation

- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| • Birmingham, AL                     | • Mobile, AL                          |
| • Low vision optometrist and OT      | • MD, optometrist, OT                 |
| • Dawn DeCarlo, OD – Clinic Director | • Joe Fontenot, MD – Medical Director |
| • (205) 488-0736                     | • (251) 476-4744                      |
| • (205) 488-0746 (fax)               | • (251) 476-4741                      |

## Questions

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