

Foundations of Effective Driving

Southern Illinois University Carbondale



Dale O. Ritzel, Ph.D., FAASE
Director Emeritus, Safety Center
Southern Illinois University Carbondale
Based upon the Chapters 7 and 8 in
Responsible Driving, AAA, 2005

Searching and Giving Meaning

- Senses can be used in many ways.
- The driver should be proactive and seek out information and always be ready for things to happen instead of reacting to things after they happen.
- The driver should use their senses to look and listen for clues in the driving environment.

Searching and Giving Meaning

- A driver can feel the wind blowing against the vehicle.
- The driver can smell burning oil or burning wire.
- The driver can see a pedestrian crossing the street ahead.
- The driver can smell burning oil and see smoke coming out from beneath the vehicle hood.

Sight/Vision

- **Most important sense used in driving**
- **The visual system consists of:**
 - The eye, especially the retina
 - The optic nerve
 - The brain

The Eye

- **Complex biological mechanism**
- **Functions like a camera, i.e., taking visible light and converting it into a stream of information transmitted via nerves**
- **Light enters the eye, passing through the cornea and pupil and then refracted by the lens.**
- **The lens inverts the light and projects an image onto the retina.**

Optic Nerve

- Information received by eye is transmitted to brain via optic nerve.
- Every second some 30-40 new images are flashed to the brain via optic nerve.
- If you see familiar image, then brain understands, if unfamiliar, then brain will have difficulty understanding the image.
- Driving in unfamiliar environment make take longer to interpret what you see.

Visual Acuity

- How well you can see.
- Is the traffic scene ahead sharp and clear?

Distance Vision

- If your distance vision is poor, you may not see hazards until it is too late to react safely.
- It takes 4 times as long to stop from 40 mph as it does from 20 mph.
- The faster you travel, the less time you have to see things and react to them.
- Distance is also affected by the state of your windshield and glasses.

Depth Perception

- Ability to judge relative distance of objects correctly.
- Need to be able to judge distances well to pass other vehicles/change lanes.
- Critical when following vehicles, pulling into traffic, and judging stopping distance.

Color Vision

- Drivers must recognize traffic signals, indicator signs, hazard warning lights and stop signs.
- Color vision problem drivers may react slower to light/signal colors.
- Do not use dark blue sunglasses because they can interfere with some drivers' ability to distinguish colors.

Night Vision

- Requires ability to see in low and variable light conditions.
- Must also recover quickly from glare of oncoming headlights and street related lights.
- Drive more slowly at night.
- Driver may not detect objects in intended path of travel and should scan darkened areas.

Glare Vision

- **Ability to see when there is rapid increase in light**
- **Examples, water, snow, oncoming headlights, sand**
- **Sunglasses might help to reduce glare**
- **Wearing sunglasses at night reduces overall vision**

Glare Recovery

- Ability of your eyes to quickly adjust from headlights back to the dark
- Can take up to 5 seconds for your eyes to adjust after being exposed to glare

Central Vision

- **3% cone of forward sharp vision**
- **Focusing on objects is done with help of central vision**
- **Area of central vision is always the same, unless you certain eye diseases**

Peripheral (fringe) Vision

- Almost 180 degree area (about 88.5° on each side of nose)
- Fringe vision detects light, objects, and side ranges of vision
- Generally fringe vision is out of focus, fuzzy
- The faster you drive, the fringe vision is reduced and the more you have to rely on central vision. That is one reason why keeping your eyes moving while driving is important

Roll, Pitch, Yaw

- **The body responds to feelings that we get while driving**
- **Vehicle movement will provide driver with various types of feedback**
- **These movements are called roll, pitch, and yaw**
- **These movements are the 3 axis around which a vehicle moves**

Backward Pitch

- Changing vehicle balance from front to rear. Occurs when acceleration is applied, where weight or center of mass is transferred toward rear of vehicle
- More rapid acceleration, greater weight transfer
- With rapid acceleration, vehicle sits on rear wheels and front of vehicle comes up
- <http://www.nasm.si.edu/exhibitions/gal109/NEWHTF/PITCH.HTM>

Forward Pitch

- Changing vehicle balance from rear to front
- When brakes are applied, weight or center of mass is transferred toward the front of vehicle
- With hard braking, the hood drops and you have reduced rear tire traction
- In dry conditions, about 70% of traction in braking comes from the front wheels
- <http://www.nasm.si.edu/exhibitions/gal109/NEWHTF/PITCH.HTM>

Roll

- Changing vehicle balance from side to side
- Sudden steering, accelerating, braking, or road elevation can affect side-to-side balance
- As you turn corners, you might feel car lean over to one side. If you begin a turn by violently turning the steering wheel, the vehicle will immediately roll a lot and may be unstable.
- <http://www.nasm.si.edu/exhibitions/gal109/NEWHTF/ROLL.HTM>

Yaw

- Changing vehicle's rear load to the right or left
- Sudden steering, braking, or right or left elevation of highway can affect rear balance resulting in loss of tire traction
- If rear tire has less traction than corresponding front tire, that rear tire will begin to slide towards the front tire
- <http://www.nasm.si.edu/exhibitions/gal109/NEWHTF/YAW.HTM>

Systematic Seeing and Scanning

- **Checking the center of the travel path**
- **Scanning and searching the traffic scene**
- **Checking inside and outside mirrors and the instrument panel**

Looking Ahead

- **Look 20 – 30 seconds ahead**
 - Two blocks in city
 - ½ mile on highway
- **Looking to side of the road**
 - Cars and people that may be in the road by the time you reach them
 - Signs warning of problems ahead
 - Signs giving you directions

Looking Ahead

- **Keep your eyes moving, both near and far**
- **Turn your head before changing lanes**
- **Watch for hazards, look beyond the vehicle ahead of you**
- **Always leave yourself an “out”**

Looking to the sides - Intersections

- **Follow these rules at intersections**
 - **Look both ways**
 - **Do not rely on traffic signals**
 - **Some drivers do not obey traffic signals**
 - **Check traffic to left/right/straight ahead before proceeding through intersection**
 - **Make sure you have a good view**
 - **If view of cross street is blocked by building, bushes, or parked vehicles edge slowly forward until you can see.**

Looking to the sides - Crosswalks

- Every intersection has a crosswalk even if not marked
- Some crosswalks have flashing lights
- Sometimes crosswalks are in the middle of the block
- Do not stop in a crosswalk

Looking to the sides – Roadside Areas

- **Look to sides of road when near:**
 - **Shopping centers and parking lots**
 - **Construction areas**
 - **Busy sidewalks**
 - **Playgrounds and school yards**
 - **Vehicles parked or disabled along the side of the roadway**

Looking Behind

- **It is important to check behind you before:**
 - **Changing lanes**
 - **Slow down quickly**
 - **Back up**
 - **Drive down a long or steep hill**

Giving Meaning

- Giving meaning, a mental process, relies heavily on sensing, a physical process
- You must be ready to give meaning
- For each traffic event, you must
 - Give meaning to each event for what it is
 - Identify each event for what it is
 - Recognize the relationship between the events and how they interact

Giving Meaning

- Giving meaning is affected by:
 - The driver's alertness
 - The amount of time taken to give meaning to the traffic situation
 - The traffic event and distractions
 - Our previous experience
 - The expectations of the happenings in traffic

Giving Meaning

- You need to be selective in regards to processing clues relating to their safe traffic path. Clues that must be considered:
 - Brake lights
 - Reverse driving lights or audible sounds
 - Lane positioning
 - Turn signal lights
 - Angle of front wheels
 - Work zones

Your own giving meaning plan

- **How to look**
- **Where to look**
- **What to look for**
 - What am I sensing?
 - What might it do?
 - What is actually happening?
 - What does it mean to me?
- **Use of Commentary Driving**

Options and Choices

- **Determining your options is a mental process**
- **When the driver determines and considers their options, they go beyond what is actually happening in a traffic situation, to making informed guesses in an attempt to answer what if questions**

Options and Choices

- Options are based on a person's knowledge, experiences, and skills
- When determining available options, you compare information to what you:
 - Know
 - Have experienced while driving or watching other drivers
 - Can do as a driver

Options and Choices

- **The driver makes assessments, interpretations, and evaluations on all information and then makes forecasts of the potential hazard becoming real. Questions include:**
 - **A vehicle slows or stops directly in front of me?**
 - **A traffic signal changes?**
 - **A vehicle moves into one of my blind spots?**
 - **I move into a vehicle's blind spot?**
 - **A pedestrian enters the roadway?**

Options and Choices

- You can size up any situation by asking yourself 3 basic questions:
 - What is happening?
 - What do I believe will happen next?
 - What can I do to increase the chance that something good will happen to me?

Assumptions

- Making informed assumptions is an essential ability to determining options
- Used in determining available options and making choice of best option.
- Example – approaching 90° turn with warning sign recommending speed of 35 mph. You assumed the advisory, posted speed was correct and that 35 mph was the maximum safe speed for the turn.

5 Basic Options

- Brake
 - Steer
 - Accelerate
 - Signal
 - Combination of the first four
-
- Your choices will help you cope with changing conditions or sudden vehicle failures and allows you to be successful in managing space, time, and visibility

Speed and Managing Time and Space

- **Driving at reasonable and proper speed for conditions**
- **Must have clear distance ahead to stop if necessary**
- **Change in visibility, traction, and space will require you to adjust your speed**

Speed Per Second

Miles per hour can easily be converted to approximate feet per second by dividing the speed in half, then adding that number to the speed

| | | | | | | |
|---------------------------|----|----|----|----|----|----|
| Miles/ Hour | 10 | 20 | 30 | 40 | 50 | 60 |
| $\frac{1}{2}$ of speed | 5 | 10 | 15 | 20 | 25 | 30 |
| Feet/ Sec. | 15 | 30 | 45 | 60 | 75 | 90 |

Stopping Distance

- You must adjust your speed to suit weather conditions, the road, visibility, and traffic
- Total stopping distance, 4 components
 - Human perception, time/space
 - Human reaction time/space
 - Vehicle reaction time/space
 - Vehicle/braking time/space

Human Perception Time/Space

- Space or distance your vehicle travels from the time your eyes see a hazard until your brain recognizes it
- Perception time – $\frac{3}{4}$ second
- Calculate human perception time/space by taking 1.1 times the speed (in mph) = perception time

Human Perception Distance

An average human perception time of $\frac{3}{4}$ second results in a reaction distance in feet of miles per hour plus the first digit of speed

| | | | | | | |
|-----------------------------------|----|----|----|----|----|----|
| Miles/ Hour | 20 | 25 | 30 | 35 | 40 | 45 |
| 1 st speed digit | 2 | 2 | 3 | 3 | 4 | 4 |
| Reaction feet | 22 | 27 | 33 | 38 | 44 | 49 |

Human Reaction Time/Space

- Distance traveled from the time your brain tells a part of your body to move until the time that body part moves
- Average driver reacts within $\frac{3}{4}$ second
- Calculate human reaction time/space by taking 1.1 times the speed (in mph) = perception time

Reaction Distance

An average reaction time of $\frac{3}{4}$ second results in a reaction distance in feet of miles per hour plus the first digit of speed

| | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| Miles/ Hour | 20 | 25 | 30 | 35 | 40 | 45 |
| 1st speed digit | 2 | 2 | 3 | 3 | 4 | 4 |
| Reaction feet | 22 | 27 | 33 | 38 | 44 | 49 |

Vehicle Reaction Time/Space

- Once brake pedal is applied there is the vehicle reaction time that depends upon the brake pedal free-play, hydraulic properties of the brake fluid, and working order of the braking system
- Vehicle reaction time usually $0 - \frac{1}{4}$ sec.

Vehicle Braking Distance

- Distance it takes vehicle to stop once you hit the brakes
- Braking distance = $0.06 \text{ times speed}^2$
- Vehicle braking capability depends on:
 - Type of braking system, braking pad material, brake alignment, tire pressures, tire tread/grip, vehicle weight, suspension system, co-efficient of friction on road surface, wind speed, slope of road, surface smoothness, braking technique used

Total Stopping Distance – Rules of Thumb

- **Double speed takes 4 times as much to stop**
- **Also your vehicle will have 4 times the destructive power in a crash**
- **You can not steer or brake a vehicle unless you have traction. Traction is the friction between the tires and road**

Total Stopping Distance – Rules of Thumb

- **Wet roads can double stopping distance. Reduce speed by 1/3 on wet roads**
- **On icy roads, reduce your speed to a crawl**
- **Empty trucks require greater stopping distance. An empty vehicle has less traction. Brakes are designed to control the maximum weight of the unit, therefore, the brakes lock up more readily when the vehicle is empty or lightly loaded. Skidding and loss of control can occur.**

Stopping Distance

Stopping distance is measured by multiplying speed in miles per hour times the first digit of speed

| | | | | |
|---|-----------|-----------|------------|------------|
| Miles/ Hour | 20 | 30 | 40 | 50 |
| 1st speed digit | 2 | 3 | 4 | 5 |
| Stopping feet | 40 | 90 | 160 | 250 |

Steering to Manage Time/Space

- One of the most used driving techniques
- Lane changing, a difficult and dangerous maneuver, is good example
- Steering should be gradual and speed should be maintained

Accelerating to Manage Time/Space

- **Sometimes acceleration is best response where other vehicles are moving towards the same space of your vehicle**
- **Another situation where acceleration can be used is where you need to quickly cross a busy street where crossing traffic does not have to stop**

Signaling to Manage Time/Space

- Use turn sign to alert other drivers of your intention
- Use horn to alert other drivers to your presence

Adjusting Speed and Vehicle Position on Curves

- Your tires can lose traction with the road if you take a curve too fast
- Techniques:
 - Slow to safe speed before entering curve
 - Braking in curve is dangerous because of locking wheels and skidding
 - Never exceed posted speed limit in curve

Managing Visibility

- **4 time frames relating to your intended path of travel:**
 - **Planning visibility**
 - **Immediate visibility**
 - **Compromised visibility**
 - **Inadequate visibility**

Planning Visibility

- 20 – 30 seconds of clear visual information
- How far down the road you need to look for closed/changing visual signs
- Trying to have appropriate information to plan a reduced risk path of travel

Immediate Visibility

- **12 – 20 seconds of clear visual information**
- **Zone where you identify objects/conditions that require a response or continuous attention so your visibility does not become compromised**

Compromised Visibility

- **8 – 12 seconds of clear visual information**
- **Action or actions the driver needs to take to restore adequate immediately visibility**

Inadequate Visibility

- 4 – 8 seconds of clear visual information
- Immediate action is required to restore greater visibility

Common Threats to Maintaining Visibility

- Fixed obstructions
- Moving obstructions
- Blind spots
- Weather
- Poor vehicle maintenance
- Glare
- Time of day

Speed and Visibility

- More speed requires more visibility
- Less visibility requires less speed
- You should always be able to stop within the distance you can see ahead
- Fog, rain, or other conditions may require you to slow down
- At night, you can not see as far with low beams as you can with high beams
- Slow down when you use low beams

Lane Position and Visibility

- Drive in center of lane
- Move closer to center line when preparing to make left turn
- Move closer to near edge of roadway when preparing to make right turn

Conspicuity

- **Conspicuity is making sure other drivers can see you**
- **Driving with low beam headlights on during day. On straight/level road**
 - **Vehicle is visible for about ½ mile without headlights on**
 - **Vehicle is visible for nearly one mile with headlights on**

Rules for Managing Space, Time, and Visibility

- Need distance for routine accelerating, decelerating, braking, and steering maneuvers
- Need space to allow for mistakes that you or others make while completing a maneuver
- Space also should provide for quick swerves or a way out of an emergency situation

Guide to Adequate Space Margin

■ Following distance

- Minimum 4 second following distance
- 5 seconds for large vehicles, motorcycles

■ Space behind

- Encourage tailgater to pass
- Avoid driving too slow for conditions
- If you must stop suddenly, make every effort to signal

■ Space to the sides

- Try to have at least one car width to side
- Best to have space of at least 8 feet on both sides
- If side space is reduced, allow more space in front

Choice of Pathways

- **Five basic locations for vehicle in lane:**
 - Center of lane (normal driving position)
 - $\frac{1}{2}$ car width to the right of lane (for preparing to make right turns)
 - $\frac{1}{2}$ car width to the left of lane (for preparing to make left turns)
 - Straddle the lane line to the left (process of changing lanes to the left)
 - Straddle the lane line to the right (process of changing lanes to the right)

Lane Space for what you cannot see

- You should leave an increased space margin for potential risk or things you can not see
- For example, provide extra space for driveways or intersections blocked from view by shrubbery, embankments or buildings
- If left lane available and free, move over one car width
- If left lane is not available, move at least $\frac{1}{2}$ car width or as close to the center of the roadway as possible

Best Path of Travel

- Which path best enhances visibility?
- Which path provides the clearest space to the sides?
- Which path provides the smoothest flow of traffic?

Separating

- Dealing with two or more objects at the same time and place, such as meeting traffic on a narrow bridge by using speed control (usually by reducing speed)
- Good timing allows you to deal with each object separately

Compromising

- **When a driver is faced with two dangerous situations, then they must give the most room to the one with the greatest consequences and chance of happening.**
- **Remember compromise is a combination of speed adjustment and lane positioning.**

Choose the Best Conditions

- Pick the best possible roadways and traffic conditions for maneuvers
- Avoid passing or changing lanes in areas of reduced visibility
- Avoid passing a big truck where there may be strong crosswinds

Timing

- **When you are busy with a maneuver, avoid any actions that are not part of the maneuver**
- **The middle of a turn is not when you downshift or adjust your sun visor**
- **Do not adjust the defroster, wipers, radio, air conditioner or heater when you pass another vehicle**