

Sensory Perception and Performance of the Driving Task

Southern Illinois University Carbondale



HED 302s – Driver Task Analysis

Dale O. Ritzel, Ph.D., FAASE

Sensory Perception and Performance

Overview of Topics Covered:

- **Sensory Modalities Critical to Driving**
- **Visual Abilities**
- **Visual Process**
- **Importance of Vision**
- **Process and Principles of Perception**
- **Principles of Effective Visual Search**
- **Perceptual Failure**



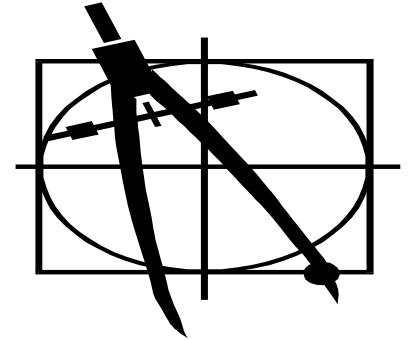
Critical Sensory Modalities

Determine how each of these are important aspects of driving. Send your summary to safety@siu.edu

- Vision
- Kinesthetic
- Tactile
- Auditory
- Olfactory



Visual Abilities



Acuity – ability to see things clearly near and far away

Distance Judgment – ability to judge distance between yourself and other objects

Contrast Sensitivity – the ability to “pick out” important items from the background view

Focus – As your eyes are proving, having the ability to clearly look at important events

Color Perception – ability to distinguish one color from another. Being able to see the color red, green, and yellow is important

Visual Process



Eye Fixations – looking at one area for a period of time (you need to do get good view, but too long can fatigue eyes)

Central Vision – the straight-ahead part of your field of vision (3-degree cone-shaped area)

Peripheral Vision – vision area left and right of central vision

Visual Skill Development



- **Targeting Skills** – target is a fixed object that appears in the center of the path you intend to drive. To select a target, first decide where you want the vehicle to travel, then aim for an object in the center of that path.
- **Searching Skills** – visualize where the vehicle will be at least 12-15 seconds before it arrives there.
- **Referencing Skills** – use reference points to know exactly where your car is positioned.
- **Systematic Process**
 - Time Required – read traffic at least 12 seconds ahead
 - Space Required – a following time from the vehicle in front of 4-8 seconds.

Vision Requirements

- **Night Vision**

On Average, A Driver Needs 29 Candela of Background Light To See Targets in Low Light Situations



- **Glare Vision**

On Average, A Driver Needs 37 Candela of Background Light to See Targets Under the Condition of Intense Glare

Detecting Useful Information

- **Factors Affecting Driver Ability**

Speed

Age

Other Drugs

Fatigue

Fitness

Alcohol

- **Peripheral Vision Reduction**

– at 30 mph...

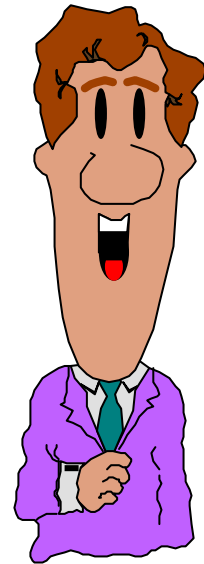
– at 45 mph...

– at 60 mph...

25% Reduced

50% Reduced

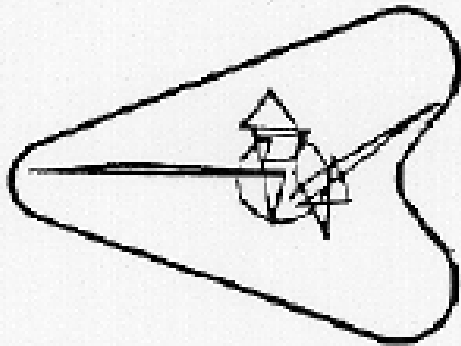
90% Reduced



Visual Movement & Fixation

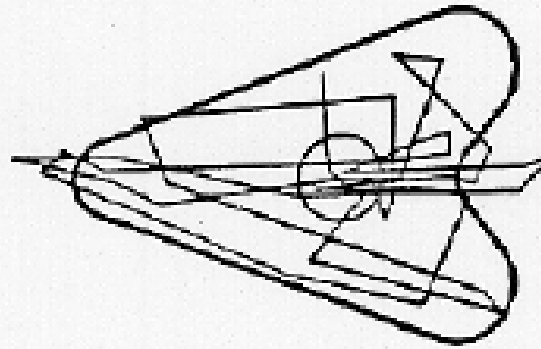
3-4

Year Old



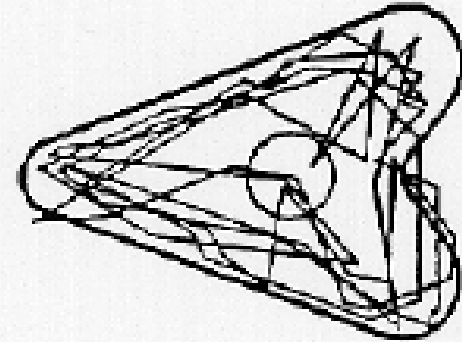
4-5

Year Old



6-7

Year Old



The lines superimposed on the arrowheads above represent the children's eye movement. To record eye movements, a light beam was reflected off the pupil and recorded by a camera. Visual movement and fixation improves with age, training, and experiences.

Managing Visibility, Time, and Space –

[note: the below concept of visual scanning was proposed by Ritzel in 1998]

- **20 to 30 Second Visual Search Area**
 - Search as far ahead as possible to identify potential conflicts
 - **Objects in Path and Areas of Limited Visibility**
 - **Limitations to POT and Limitations to LOS**
- **12 to 15 Second Visual Control Area**
 - Identify Objects or Conditions That Require A Response or Continuing Attention
 - Look for Closed or Changing Visual Zones

Managing Visibility, Time, and Space

- **8 to 12 Second Response Area**
 - Identify an Alternate POT and Safe Stopping Zone
 - Evaluate Open Zones To The Side and Rear
- **4 to 8 Directed Response Area**
 - Other than Detecting Color or Movement, the Brain Receives Definitive Information (Images) from the Eyes Only When the Eyes Fixate.
 - The Eyes Fixate Only on That Which the Brain (through practice and experience) Directs Them To Fixate.

PERCEPTION

The process by which an individual receives or extracts information about the environment and attaches or assigns meaning to it.

- **Sensory Impulses Take On Emotional Characteristics**
- **Value Elements Color Our Perception of People and Events**
- **When Values Are Realistic; Perceptions Are Realistic**

The competent driver is one whose perceptions correspond most closely with reality...

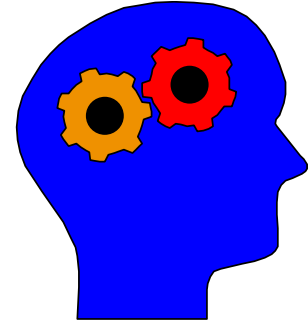
Perception Principles

**FINAL FILES ARE THE RESULT
OF YEARS OF SCIENTIFIC
STUDY COMBINED WITH THE
EXPERIENCE OF YEARS.**

Principles of Perception

Mental Set

- We Perceive What we are Looking For
- We First See What we are Taught To Look For
- What We Perceive Depends Greatly on Previous Learning



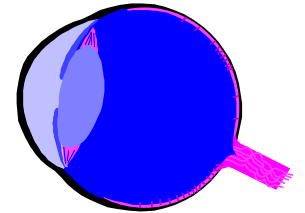
Grouping

- We Perceive Related or Classified Events Easily
- Classification Leads to Efficient Observation

Principles of Perception

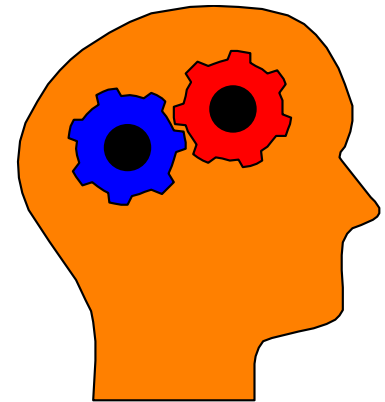
Perception Takes Time and is Selective

- Involves Senses and Mind
- Can Only Interpret/Analyze Information Given
- Cannot see Everything, Selection is Critical
- Eyes Transmit Millions of Impulses, Brain Can Handle Limited Number Within a Time Frame



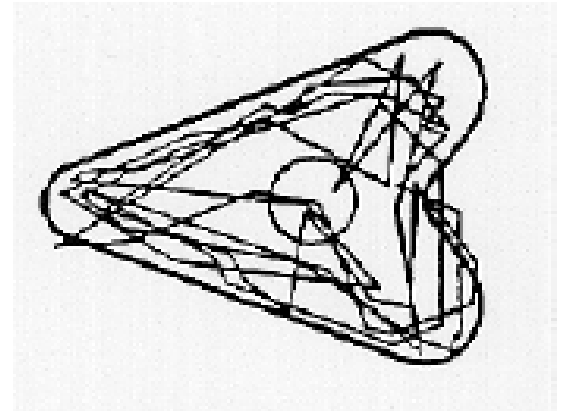
The Human is an Integrated Being

- Perceive What is Meaningful
- Closer to Reality, Closer to Accurate Performance

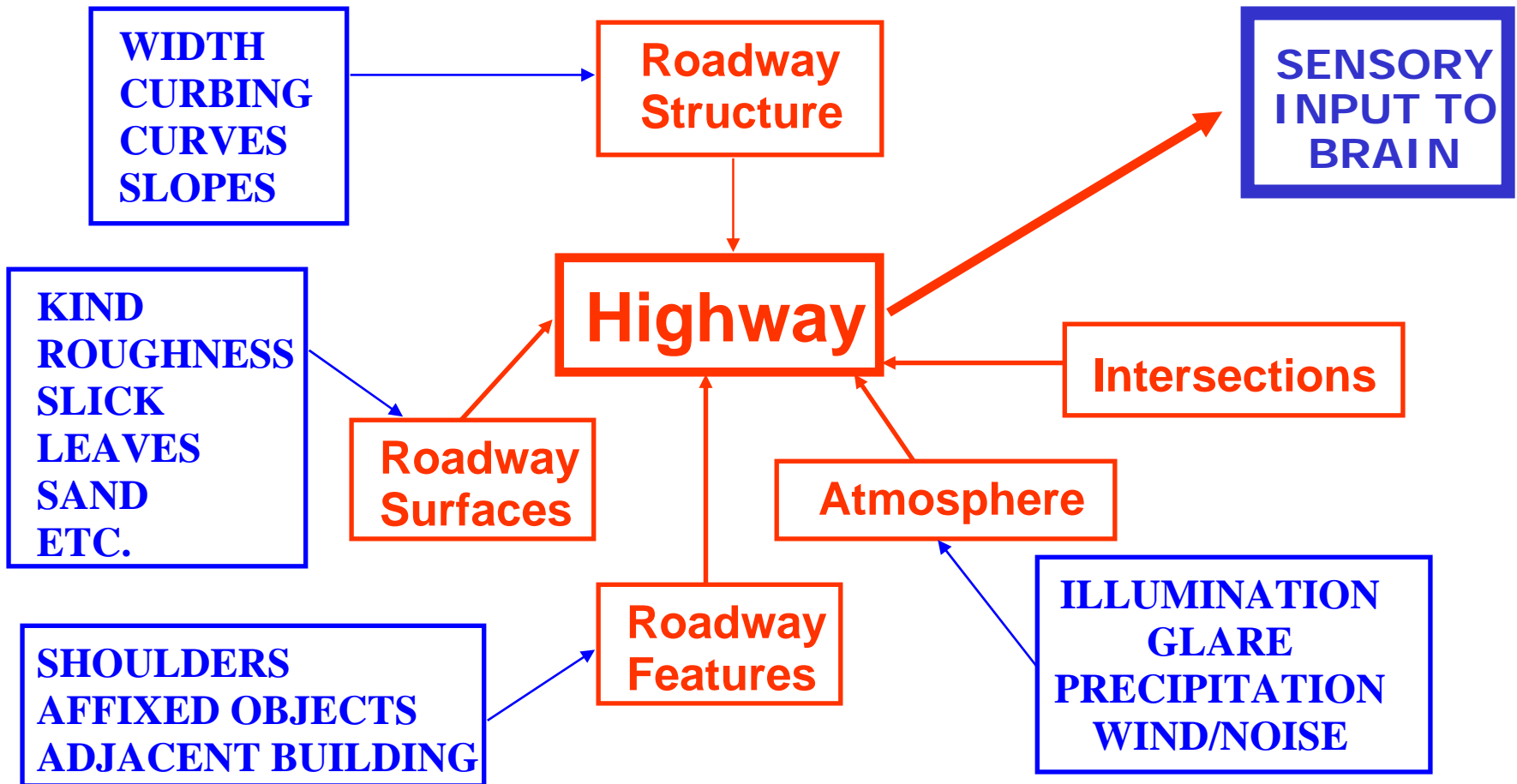


Visual Search Categories

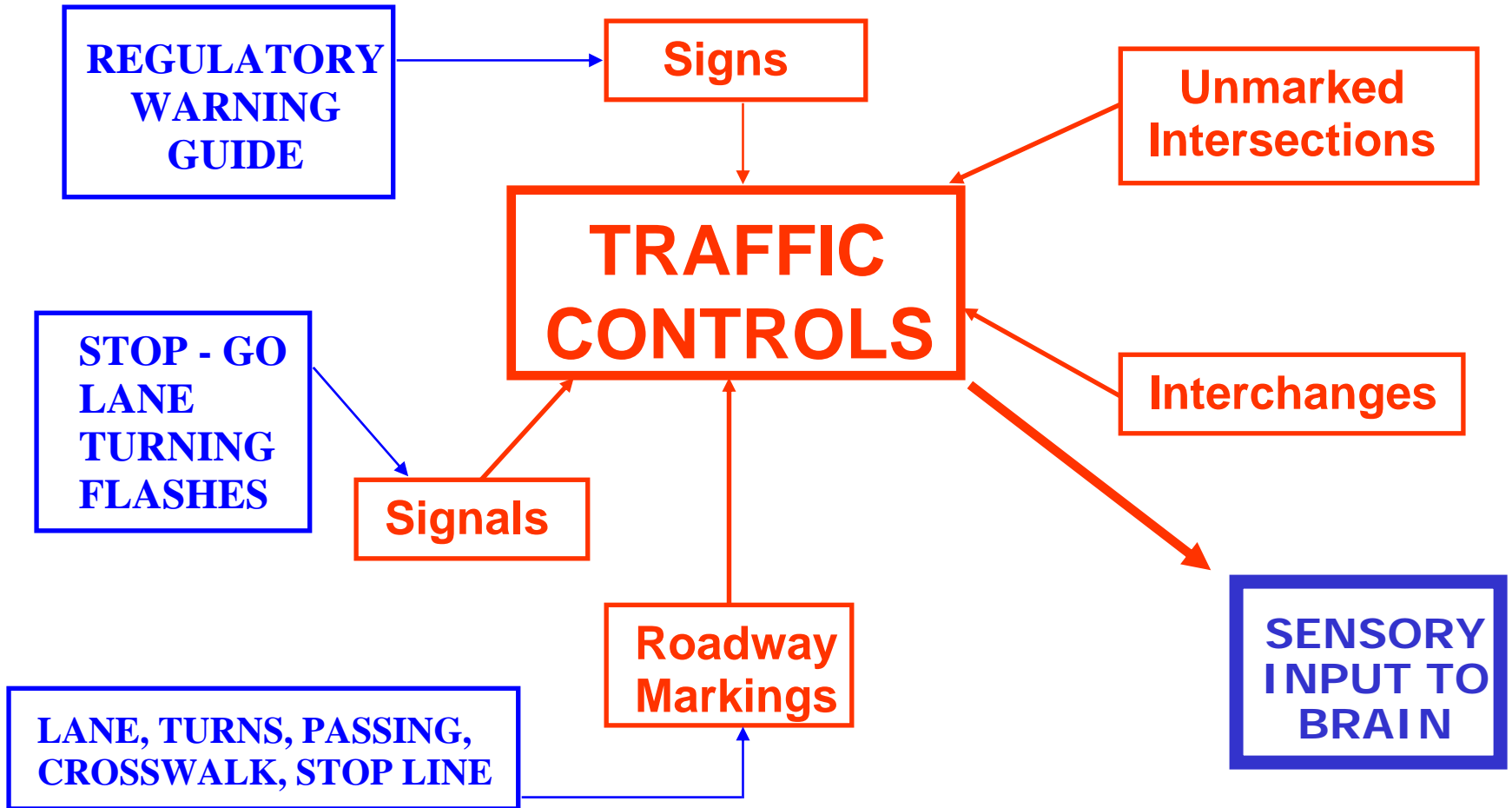
- **Highway**
- **Traffic Controls**
- **Motor Vehicles**
- **Non-motorized Users**
- **Basic Concept – Keep eyes moving every 2-5 seconds**



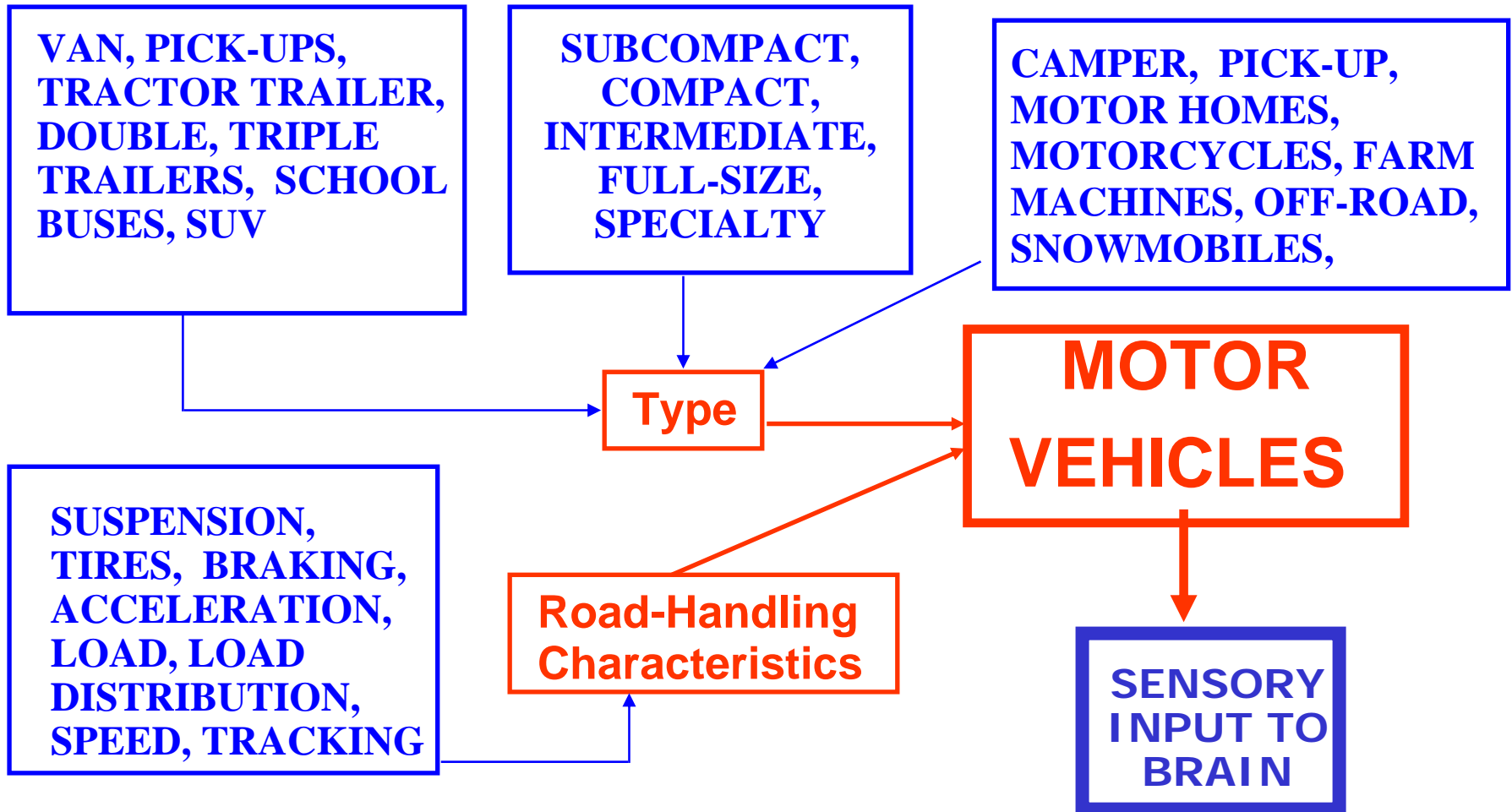
Visual Search Categories



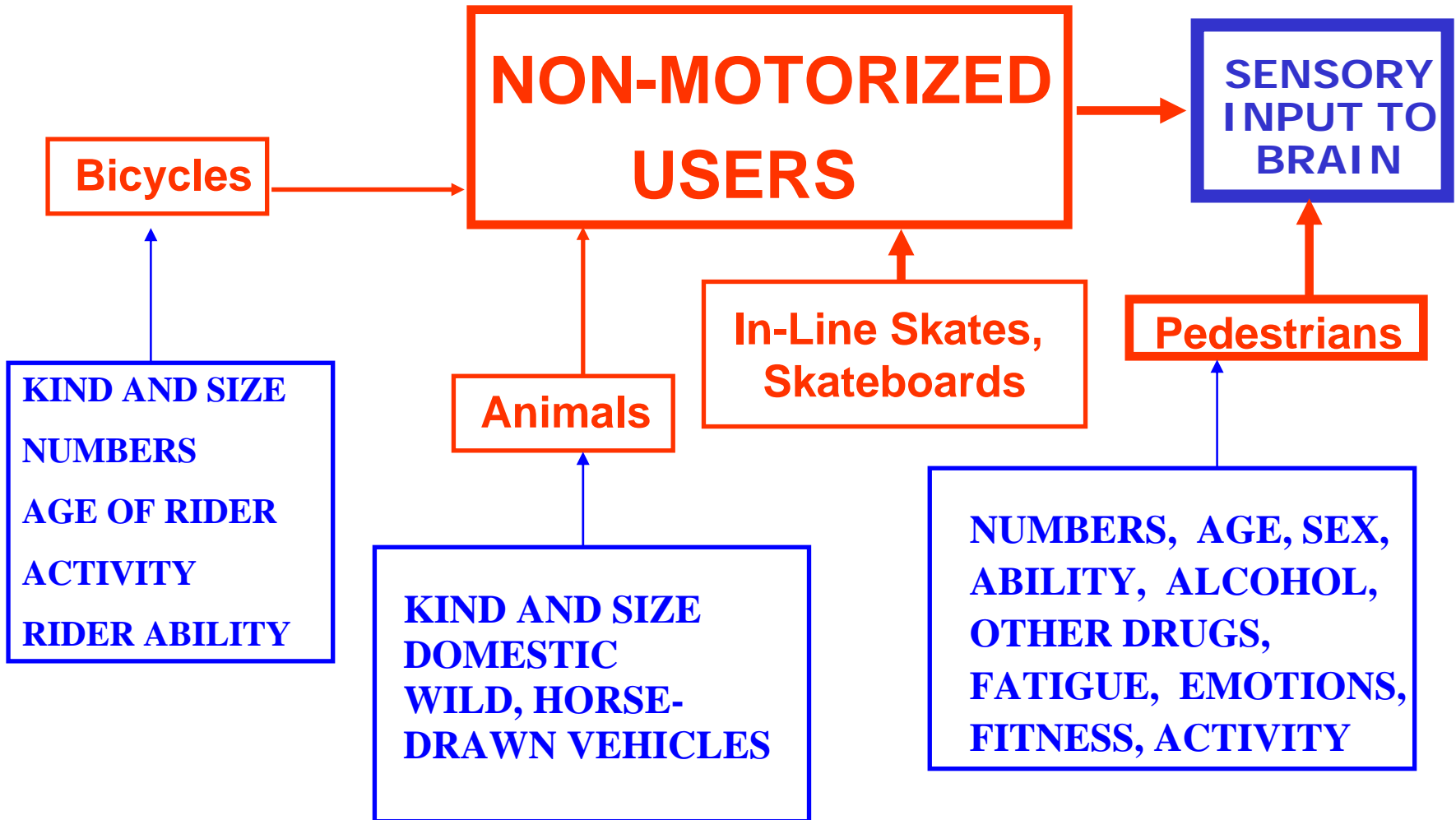
Visual Search Categories



Visual Search Categories



Visual Search Categories



Vision Changes

- **Visual Abilities Change With Age**
- **Eye Muscles Tire More Easily**
- **Eye Muscles Become Elastic**
- **Glare Recovery Slows**
- **Eye Opacity Increases**



Vision Changes

- **Field of Vision Narrows**

- **Pupil Size Is Reduced**



- **Static Visual Acuity Diminishes**

- **Dynamic Visual Acuity Diminishes**

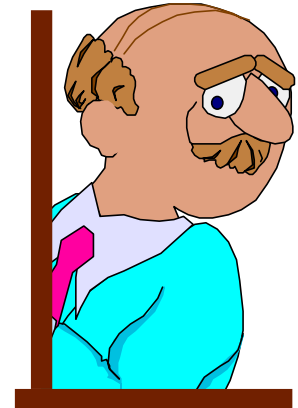
Vision Changes

- **Static Depth Perception Worsens**
- **Dynamic Depth Perception Worsens**
- **Dark Adaptation Worsens**
- **Glare Sensitivity Increases**



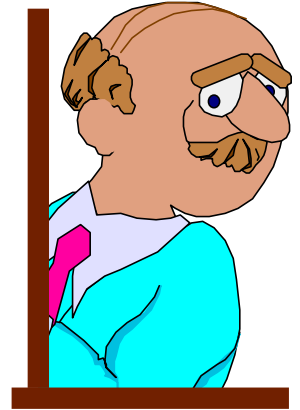
Improving Night Vision

- **Adjust Speed to Range of Headlights**
- **Keep Eyes Searching Into Path of Travel (POT)**
- **Look to Side Or Past Objects**
- **Protect Eyes from Glare**
- **Keep Glass and Lenses Clean**



Improving Night Vision

- **Use Headlights With Purpose**
- **Make it Easy for Others to See You**
- **Avoid Prolonged Driving Near Bedtime**
- **Select Vehicles Without Full Tinted Windshields**
- **Increase Following Interval (4-8 seconds)**



Assignment

- **After reviewing the following units**
 - Sensory Perception and Performance of the Driving Task**
 - Searching Techniques**
 - SIPDE**
 - The Smith System**
- Check with the course syllabus as to where you can view the 6 units of the Driving Perception video series by Dr. Jack Weaver and then take the Driving Perception Video Test**