October 28-29, 2025
Orlando, FL

TRANSPORTATION SYMPOSIUM

Human Factors in Safety Engineering

Loreen Bobo, PE (D5)
Kari Pucker, PE, PTOE, RSP1
Mario Dipola, PE, PTOE, RSP2I, MBA

Transportation Symposium Website

SCAN ME

1

Our Safety Challenge

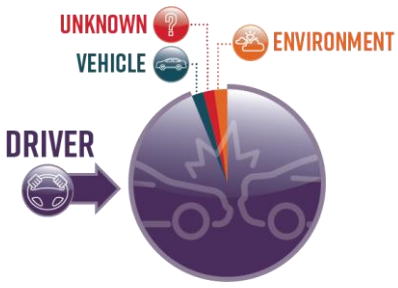
ON FLORIDA'S ROADS...

Daily Fatalities

Daily Serious Injuries

Source:
Florida Strategic Highway Safety Plan, 2021

NATIONALLY...

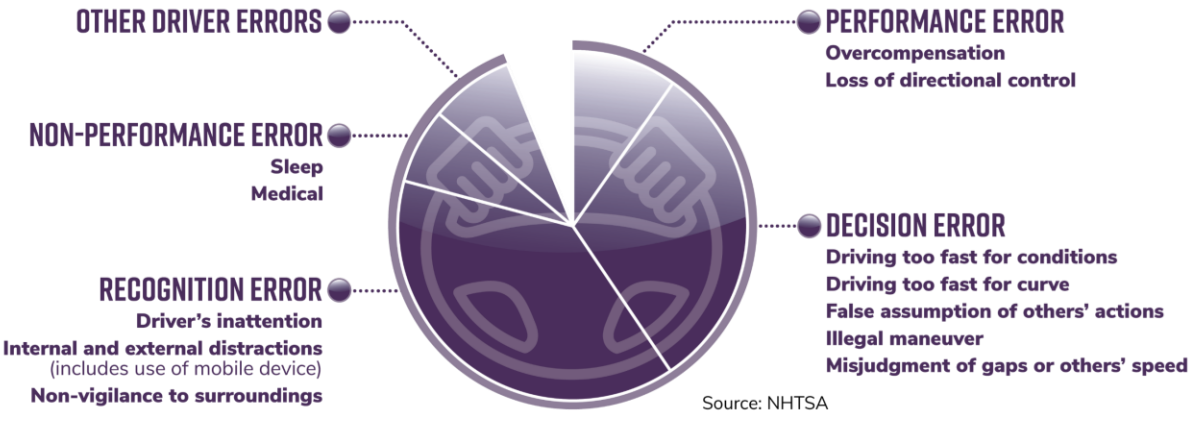


MAJORITY OF CRASHES INVOLVE
DRIVER ERROR
AS A CONTRIBUTING FACTOR

Source: NHTSA

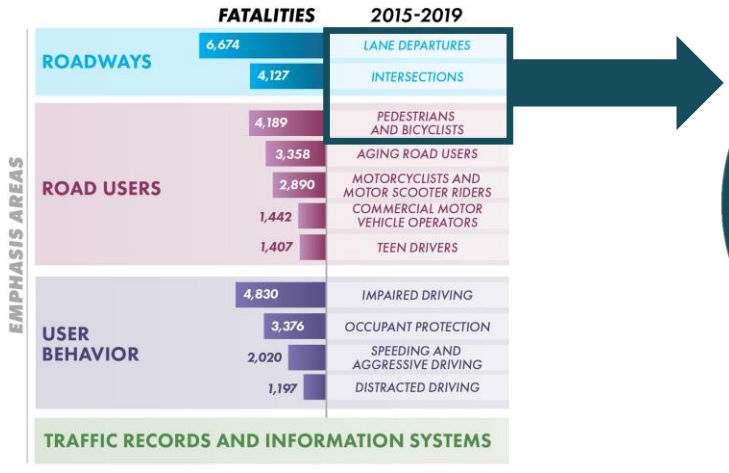
2

National - Driver Related Factors



3

Emphasis Areas



4

What is/are Human Factors?

A. The name of a 1980's rock and roll group

B. The former title of the EIS section describing Community Impacts

C. Exponents used with *Natural* logarithms

D. Study of human traits and behaviors

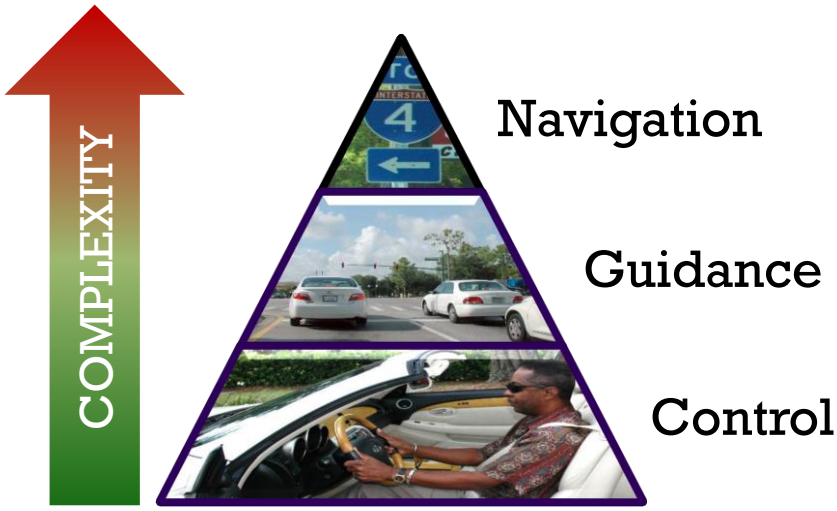
E. Programs to combat distracted and impaired driving

What is/are Human Factors?

- Scientific discipline concerned with the understanding of interactions among humans and other elements of a system
- Profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance

Definitions from the Human Factors and Ergonomics Society

Driving is Multi-Tasking



7

Driving Comprised of Subtasks

- **Control**: Keeping the vehicle at a desired speed and heading within the lane

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Driving Comprised of Subtasks

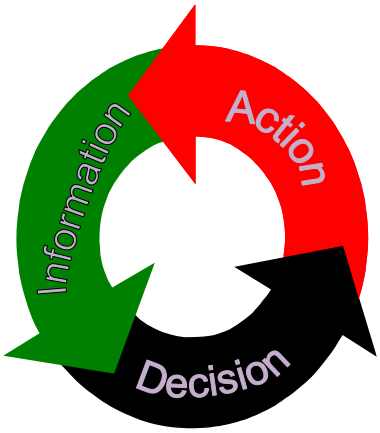
- **Guidance**: Interacting with other vehicles (following, passing, merging, etc.) by maintaining a safe following distance and by following markings, traffic control signs, and signals;
- Control: Keeping the vehicle at a desired speed and heading within the lane

Driving Comprised of Subtasks

- **Navigation**: Following a path from origin to destination by reading guide signs and using landmarks
- Guidance: Interacting with other vehicles (following, passing, merging, etc.) by maintaining a safe following distance and by following markings, traffic control signs, and signals;
- Control: Keeping the vehicle at a desired speed and heading within the lane

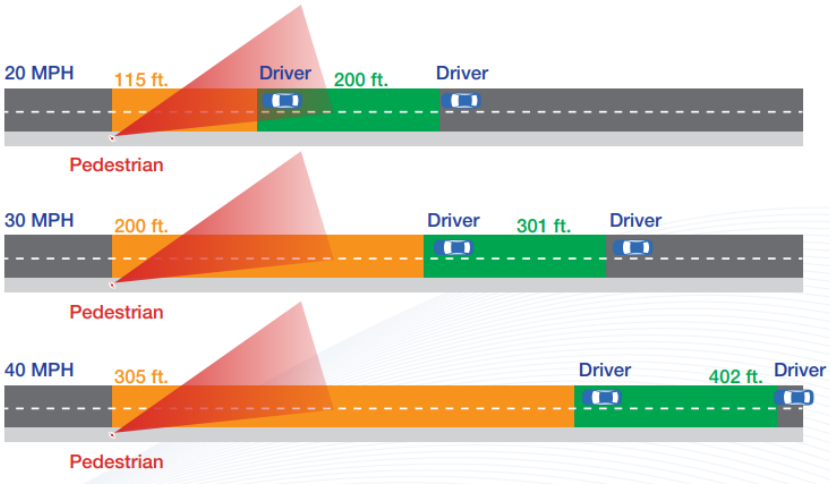
Steps to Successful Task Performance

- Gather and filter available information
- Interpret the relevant information and choose an action
- Execute the action
- All the while, maintaining the pyramid of Control – Guidance – Navigation



11

Speed, Distance, and Ability to Stop or Yield



Speed and Driver's Vision

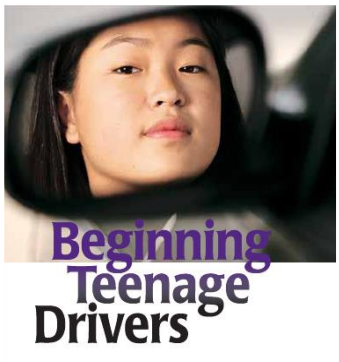
Driver's Peripheral Vision at 10-15 MPH

Driver's Peripheral Vision at 30-35 MPH

Driver's Peripheral Vision at 20-25 MPH

Driver's Peripheral Vision at over 40 MPH

Young Drivers – Undeveloped Abilities



- Less time behind the wheel
  - Tend to overestimate their driving skill
  - Underestimate collision risk
  - Less experience recognizing potential hazards
  - Tend to need longer perception time
  - Underdeveloped vehicle maneuvering and visual scanning skills
- Pressured by Peers

Aging Drivers – Aging Gracefully?

- ✓ Years of experience
- ✓ Well honed skills
- ✓ Driving almost robotic

- ▪ Declining vision
- ▪ Potential cognitive challenges
- ▪ Physical decline

Elements of a System

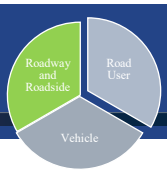
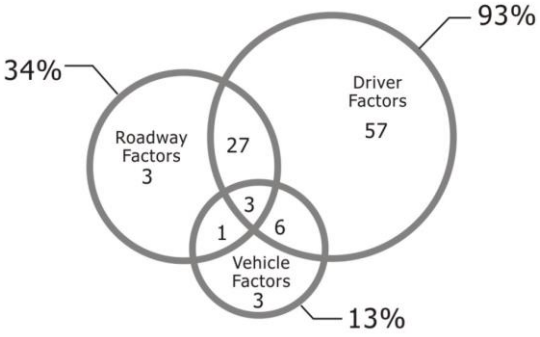


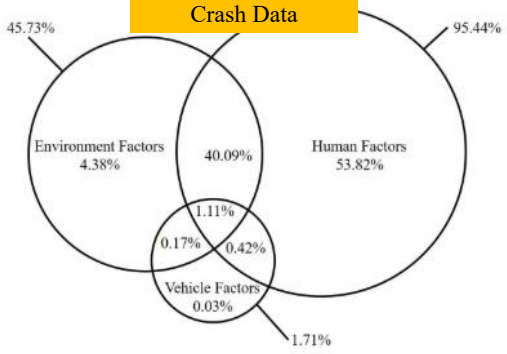
Exhibit 3-3: Contributing Factors to Vehicle Crashes

Based on 1970s Crash Data



Treat, J.R., Tumbas, N.S., McDonald, S.T., Shinar, D., Hume, R.D., Mayer, R.E., *et al.* (1979) Tri-Level Study of the Causes of Traffic Accidents Executive Summary. DOT HS 805-099. Transportation Research Institute (UMTRI)

Based on 2017-2022 Crash Data



Dong, Y. and Wood, J. (2025) Evaluation of Crash Contributing Factors. *Journal of Transportation Technologies*, **15**, 155-178. doi: 10.4236/jtts.2025.151009.

Human Error and System Failure

- Principle 1:
  - Humans can only do that which is humanly possible
- Principle 2:
  - If the system demands more of the human than is humanly possible, then one or more errors will occur
- Principle 3:
  - If errors occur, the system may fail
- Principle 4:
  - If the system fails, inefficiencies and/or injuries will result

Safe System Principles

Death/serious injury is unacceptable

Humans make mistakes

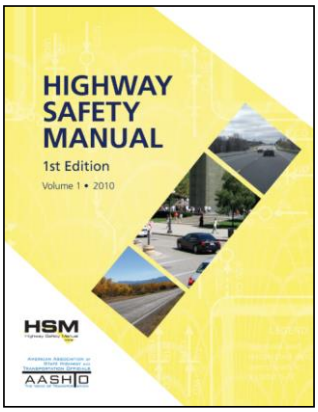
Humans are vulnerable

Responsibility is shared

Safety is proactive

Redundancy is crucial

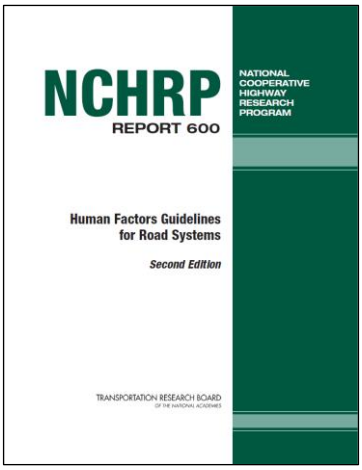
Goal of Understanding Human Factors



"The goal of understanding the effects of human factors is to reduce the probability and **consequences of human error** . . . by designing systems with respect to *human characteristics and limitations*"

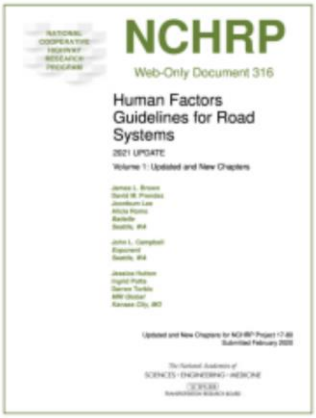
AASHTO Highway Safety Manual: www.highwaysafetymanual.org

Human Factors Guidelines for Road Systems



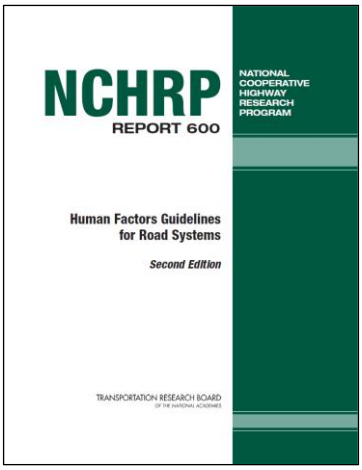
- Intended to provide human factors principles and findings to highway designers and traffic engineers.
- Allows a non-expert in human factors to more effectively bring consideration of the road user's capabilities and limitations into the practice of design, operations, and safety.

HFG 2021 Update



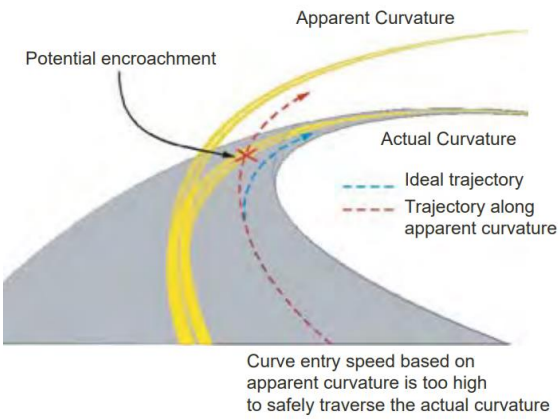
- NCHRP Web-Only Document 316, Volume 1, is an addendum to the HFG Second Edition. It expands upon the 2nd Edition with three new chapters: Pedestrians, Bicyclists, and Roundabouts.
- In addition, it provides updated information to three guideline chapters that are included in the Second Edition HFG

Human Factors Guidelines for Road Systems

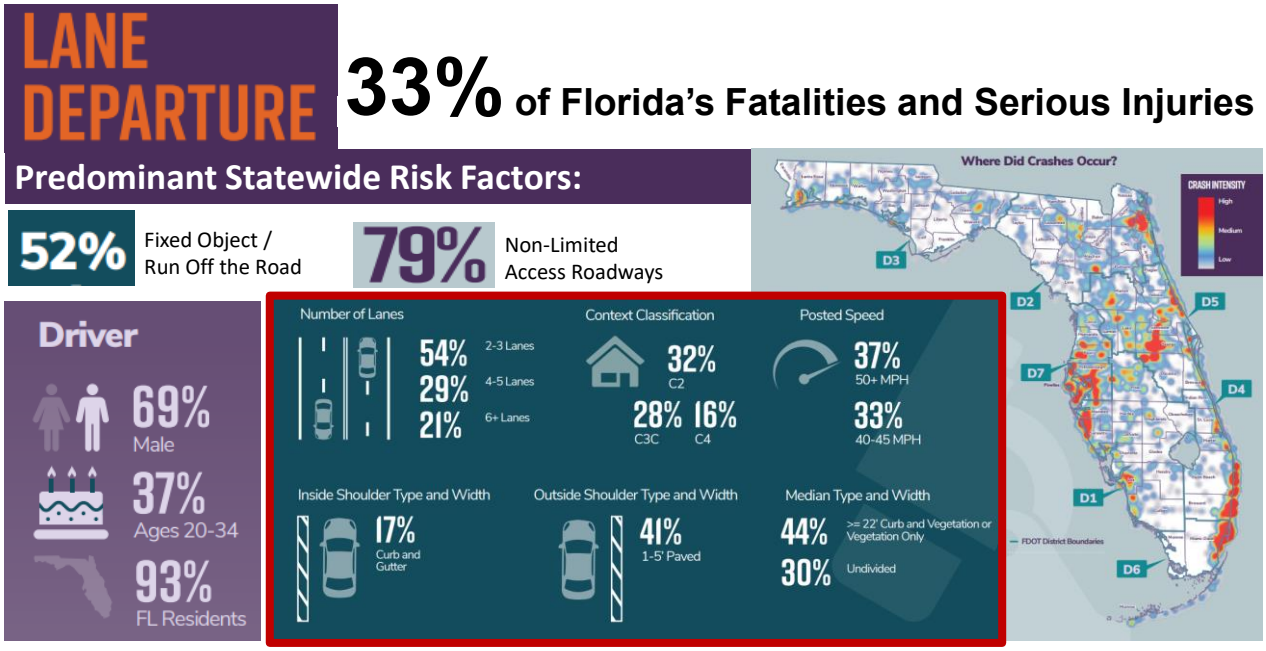


- The HFG serves as a complement to other primary design references and standards. It does not duplicate or replace them. It is an additional tool for the engineer to use in designing and operating roadways that are safely usable by the broad range of road users.

Influence of Perceptual Factors on Curve



- Driver's use visual information to assess the degree of curvature of an upcoming curve and use their perception of the curve's radius for making speed and path adjustments.
- The curve radius as seen from the driver's perspective is called the "apparent radius".
- In cases of a vertical sag superimposed on a horizontal curve, the driver's "apparent radius" makes the horizontal curve appear flatter and they may adopt a faster curve entry speed.



Statewide Rumble Strips Initiative

- Approximately **3,000 Centerline Miles** Statewide
- **$60 Million** of Funding for FY23 through FY26 Design, Construction & CEI

CENTER RUMBLE STRIPS ARE EXPECTED TO REDUCE CRASHES BY **46%**

SHOULDER RUMBLE STRIPS ARE EXPECTED TO REDUCE CRASHES BY **51%**

THE **SINUSOIDAL WAVE DESIGN** ENSURES LOWER NOISE LEVELS FOR ADJACENT PROPERTY OWNERS AND SAFER FOR ALL ROAD USERS.

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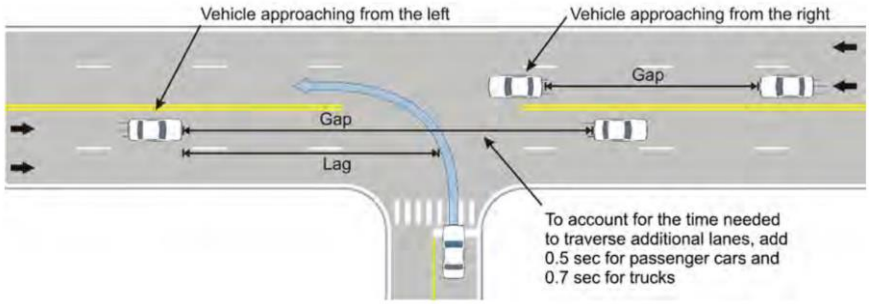
Left-Turns at Unsignalized Intersections



- Most left-turn crashes at unsignalized intersections are caused by misjudged gaps.
- Driver perception of approaching vehicle speed is challenging, which may cause accepting smaller (less-safe) gaps if speeds of oncoming vehicles are higher.

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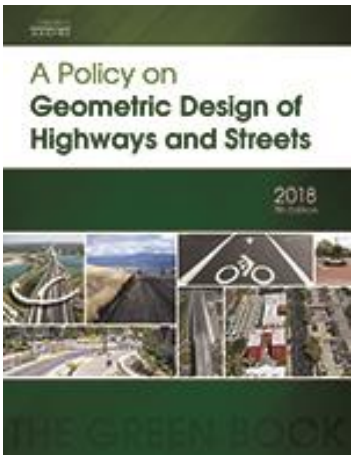
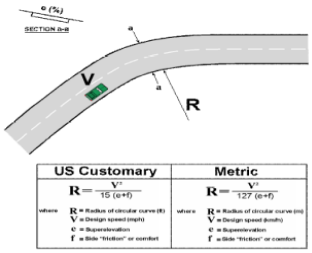
Positive Guidance

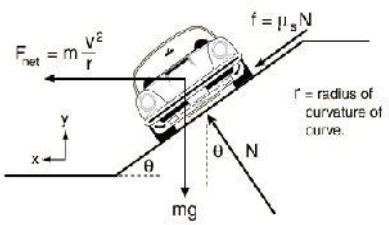
- If designs are incompatible with driver attributes, or
- if the information displays are ambiguous or erroneous, or
- if expectancies are violated, drivers will commit errors, and *system failures* may result.

Design Consistency

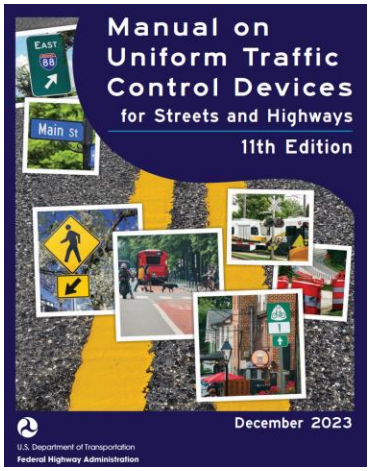


- Familiar, comfortable patterns of cross-section, line and grade, among common roadway types and within specific facilities



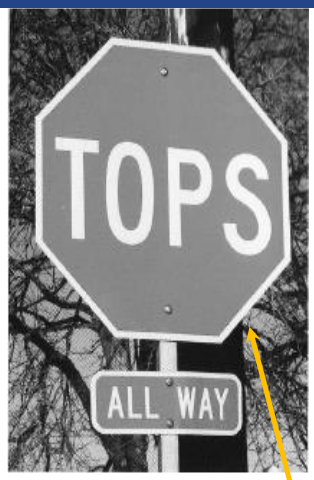


Traffic Control Devices - Uniformity

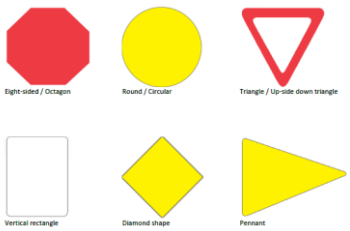


- Uniformity of the meaning of traffic control devices is vital to their effectiveness.
- Uniformity means treating similar situations in a similar way.
- Uniformity of devices:
  - simplifies the task of the road user
  - assists road users, law enforcement officers, and traffic courts by giving everyone the same interpretation
  - assists public highway officials through efficiency in manufacture, installation, maintenance, and administration.

Redundancy in Uniformity



- Shapes and colors alone convey essential information without relying on words



Uniformity in design shall include shape, color, dimensions, legends, letter style, borders, and illumination or retroreflectivity.
MUTCD Section 2A.04 – Design of Signs

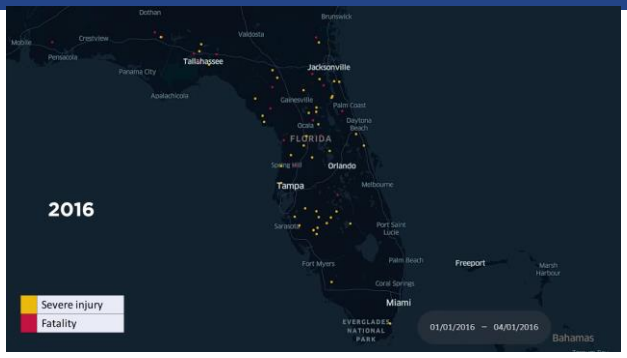
Drivers continued to stop; 87% saw nothing unusual

Redundancy in Application

- Say the same thing in <u>more than one way</u>
- How many ways are depicted here?

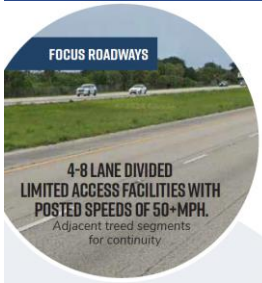
Statewide Systemic Safety Strategy

Severe Crashes Are Rare and Random:

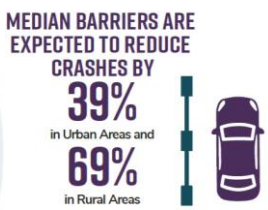


Identify common roadway characteristics when crashes are severe → Screen the road network for where those conditions exist → Identify safety infrastructure to deploy statewide → Compare investment options for highest B/C impact → Track deployment and evaluate effectiveness

Statewide Median Barrier Initiative



- Approximately **121 Centerline Miles** Statewide
- **$130 Million** of HSIP and State Funding for FY27 & FY28 Design, Construction & CEI



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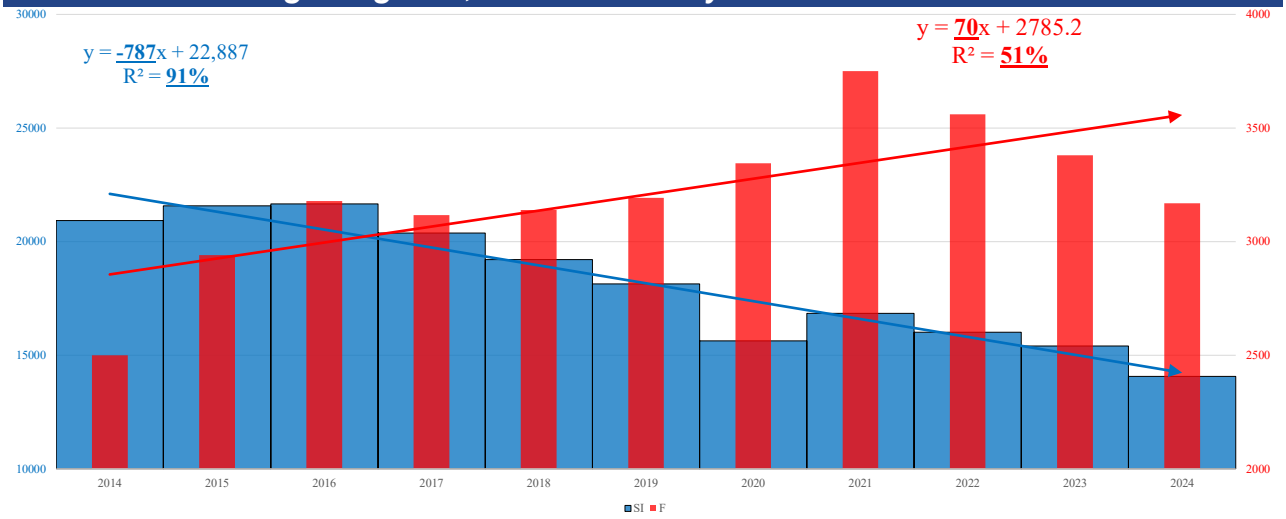
Leveraging Our Collective Expertise

- Law **E**nforcement
- **E**ngineering
- **E**mergency Medical Services
- **E**ducation
- *Everyone!*

Paradigm Shift

We're Making Progress, but Dichotomy in Trends



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Paradigm Shift – Egregious Fringe

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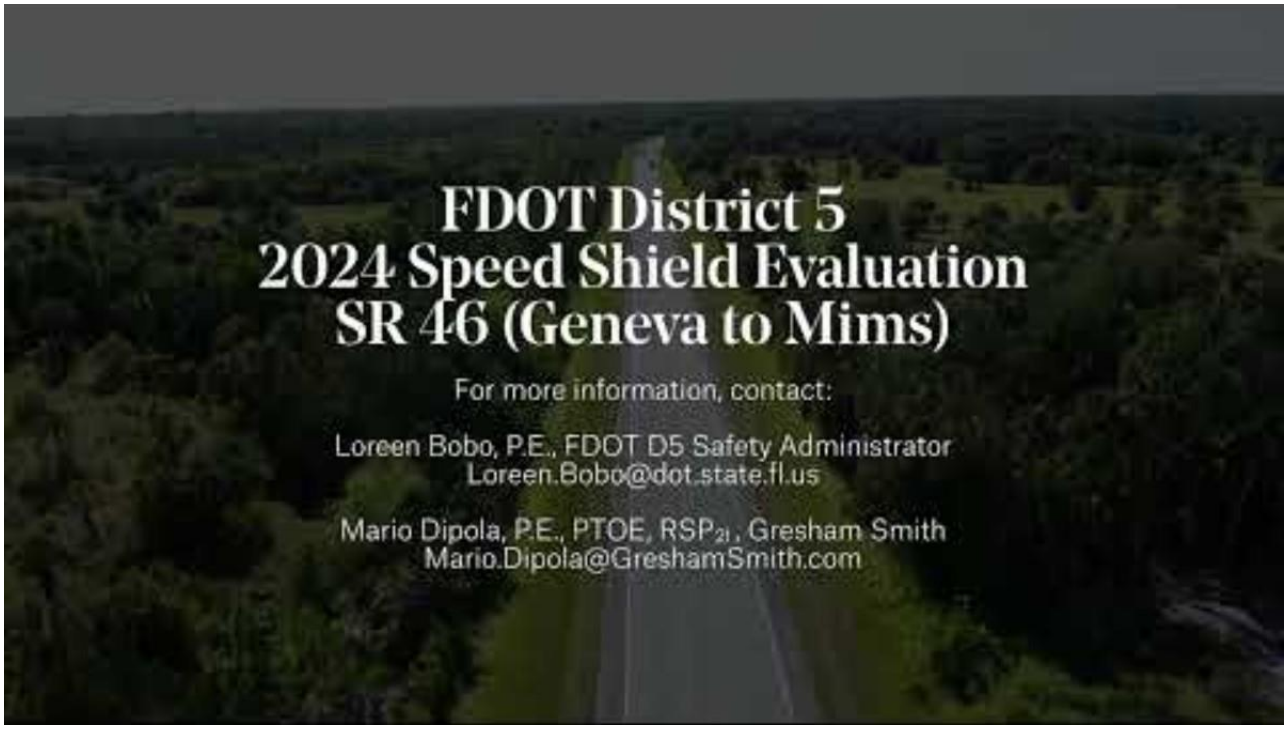

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Speed Shields – SR 46 between Geneva & Mims

- Human Factors Relating to Traffic Control Devices
  - Timing
  - Primacy
  - Expectancy
  - Redundancy

FDOT

TARGET ZERO FATALITIES & SERIOUS INJURIES

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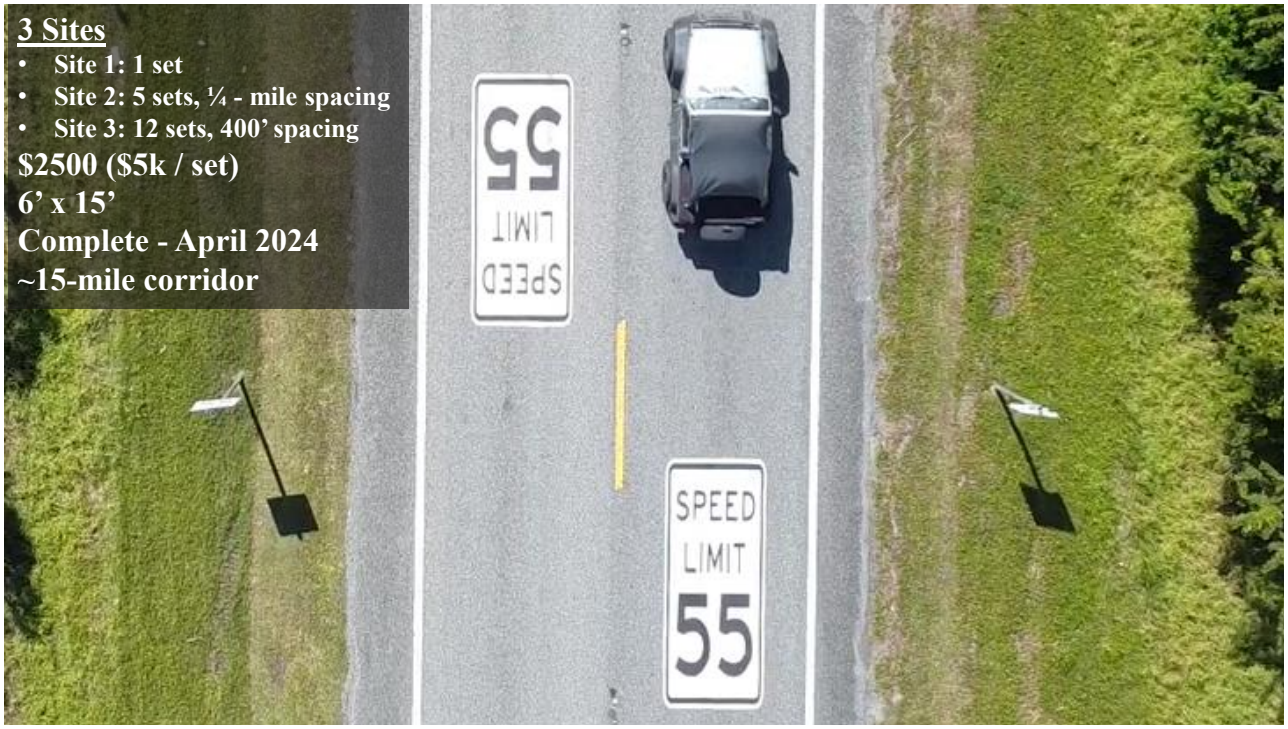
3 Sites
• Site 1: 1 set
• Site 2: 5 sets, ¼ - mile spacing
• Site 3: 12 sets, 400' spacing
$2500 ($5k / set)
6' x 15'
Complete - April 2024
~15-mile corridor
SPEED LIMIT 55
SPEED LIMIT 55

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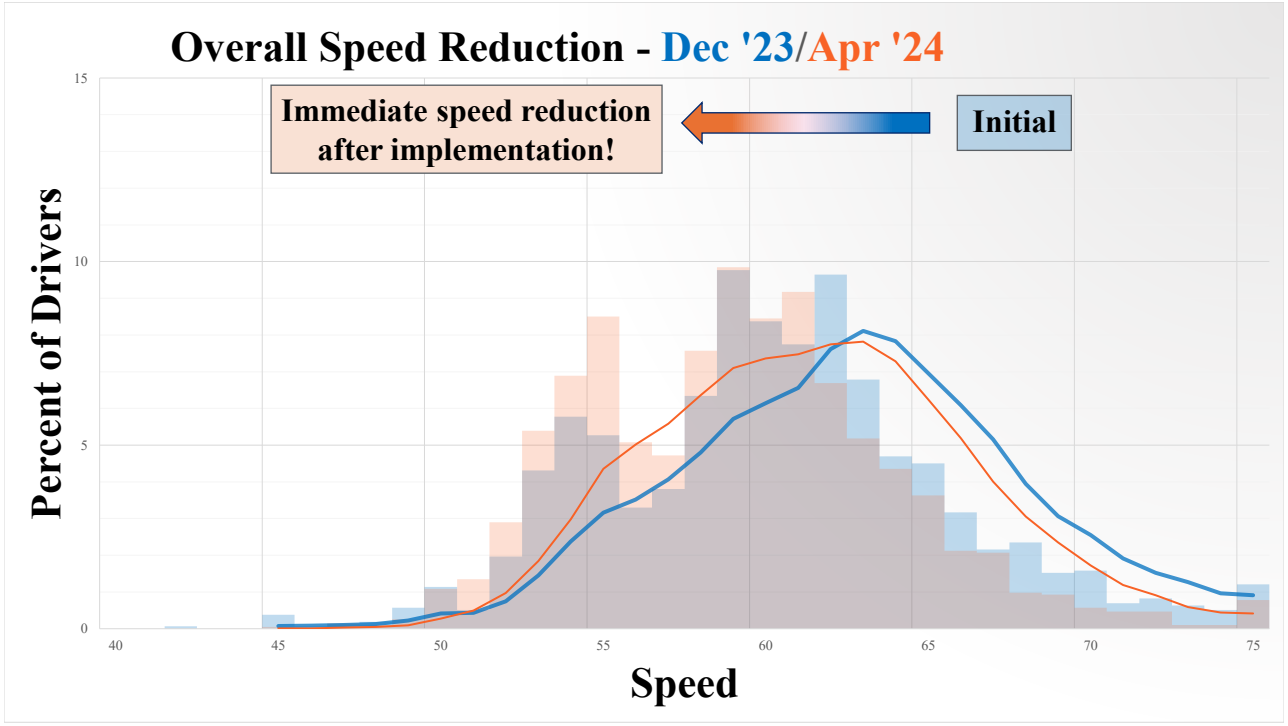
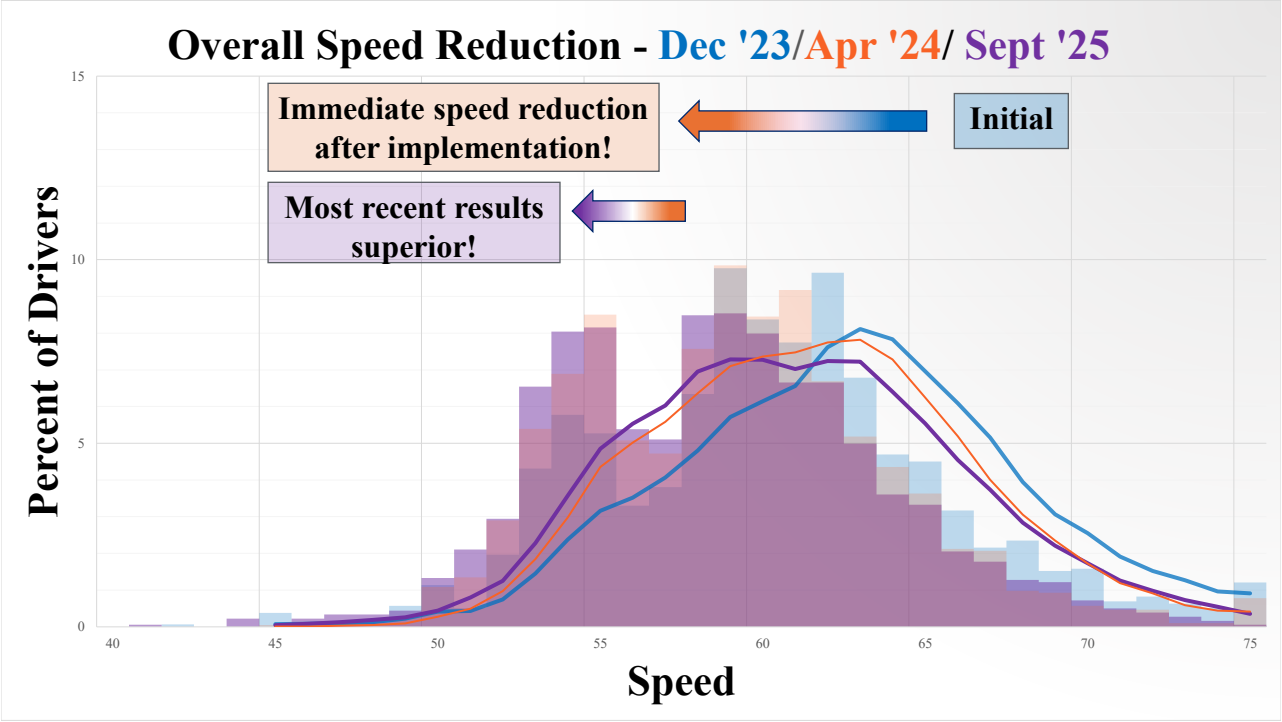

Overall Speed Reduction - Dec '23/Apr '24
Immediate speed reduction after implementation!
Initial
Percent of Drivers
Speed
0
5
10
15
40
45
50
55
60
65
70
75

40



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Speed Shields – Results

% Change	Site 1 (1 set)		Site 2 (5 sets @ 1/4 mi)		Site 3 (12 sets @ 400')		Eastbound (all 3 sites)		Westbound (all 3 sites)		Upstream (all 3 sites)		Midpoint (all 3 sites)		Downstream (all 3 sites)		Overall	
	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25	4/'24	9/'25
Average	-1.6%	-1.8%	-0.7%	-2.2%	-2.5%	-3.5%	-2.0%	-2.7%	-2.0%	-3.2%	-2.6%	-3.4%	-1.2%	-2.3%	-1.5%	-2.5%	-2.0%	-3.0%
50 %ile	-2.6%	-2.6%	-0.6%	-2.5%	-2.3%	-3.0%	-1.7%	-2.7%	-2.3%	-3.1%	-2.2%	-3.3%	-1.2%	-2.4%	-1.8%	-2.4%	-1.9%	-2.9%
85 %ile	-1.9%	-1.2%	-1.0%	-1.3%	-3.1%	-4.0%	-2.7%	-2.7%	-2.2%	-2.9%	-3.3%	-3.1%	-1.7%	-3.3%	-1.8%	-1.7%	-2.4%	-2.8%
95 %ile	-4.6%	-1.8%	-1.7%	-1.1%	-4.5%	-5.4%	-3.7%	-3.1%	-4.0%	-4.3%	-4.8%	-4.9%	-3.0%	-2.4%	-2.5%	-2.1%	-3.7%	-3.5%
10 mph pace	-1.6%	-7.9%	0.0%	-14.3%	-3.1%	-10.8%	-1.6%	-6.3%	-1.6%	-7.9%	0.0%	-6.3%	-1.6%	-4.8%	-1.6%	-7.9%	-1.6%	-6.3%
EF (10+)	-39.3%	-19.8%	-17.2%	-21.3%	-40.2%	-50.2%	-39.9%	-37.4%	-33.0%	-38.7%	-44.0%	-41.5%	-27.1%	-39.9%	-28.1%	-25.5%	**-36.2%**	**-38.1%**
EF (15+)	-57.0%	-32.2%	-29.4%	-44.1%	-63.9%	-75.7%	-56.4%	-53.7%	-53.0%	-64.6%	-63.6%	-68.3%	-52.7%	-44.1%	-36.1%	-56.9%	**-54.4%**	**-59.3%**

Over a third of 10+ mph eliminated

Over half of 15+ mph eliminated

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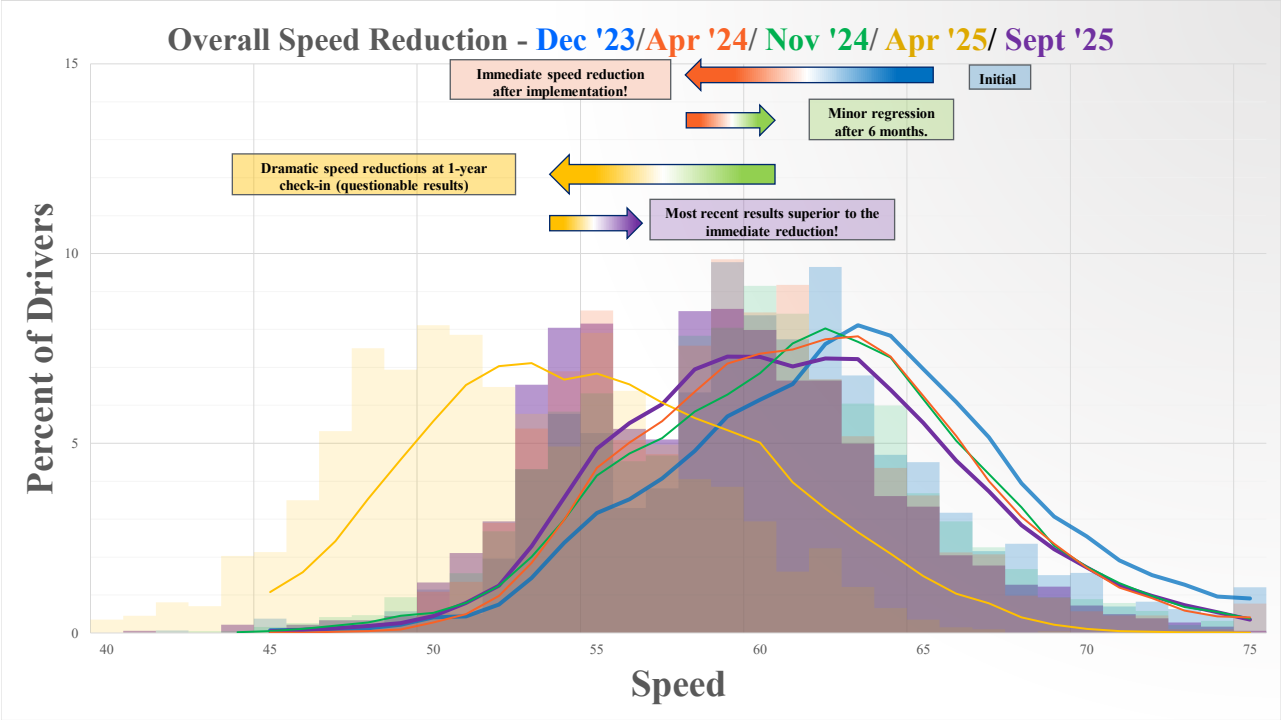
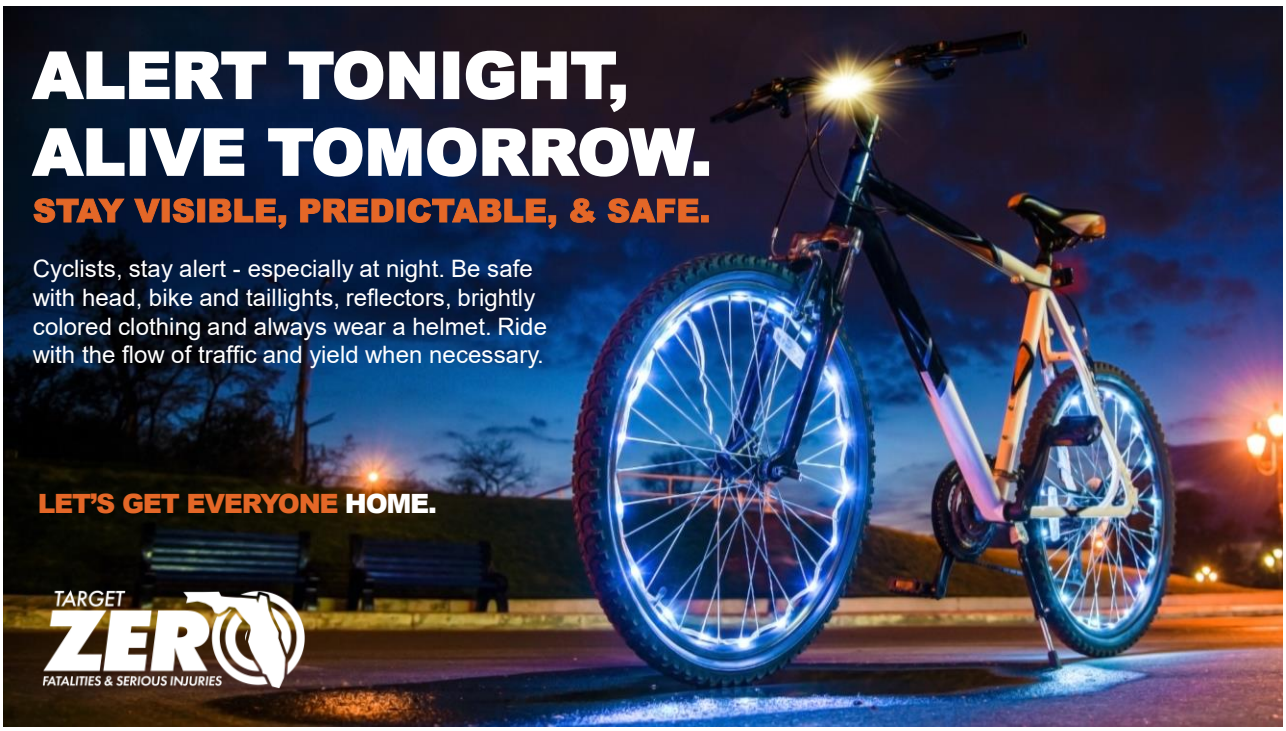
Foveal Vision = ±4°

5 Criteria for any Traffic Control Device

1. Fulfill Need
2. Command Attention
3. Convey Clear, Simple Meaning
4. Command Respect
5. Give Adequate Time for Response


Overall Speed Reduction - Dec '23/Apr '24/ Nov '24/ Apr '25/ Sept '25
Immediate speed reduction after implementation!
Initial
Minor regression after 6 months.
Dramatic speed reductions at 1-year check-in (questionable results)
Most recent results superior to the immediate reduction!
Percent of Drivers
Speed
0
5
10
15
40
45
50
55
60
65
70
75

45


ALERT TONIGHT,
ALIVE TOMORROW.
STAY VISIBLE, PREDICTABLE, & SAFE.
Cyclists, stay alert - especially at night. Be safe with head, bike and taillights, reflectors, brightly colored clothing and always wear a helmet. Ride with the flow of traffic and yield when necessary.
LET'S GET EVERYONE HOME.
TARGET ZERO
FATALITIES & SERIOUS INJURIES

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Contact Us

Loreen Bobo, P.E.
Loreen.Bobo@dot.state.fl.us
Office: 386.943.5446

Kari Pucker, PE, PTOE, RSP_1
Kari.Pucker@GreshamSmith.com
Office: 904.328.2105

Mario Dipola, PE, PTOE, RSP_{2I}, MBA
Mario.Dipola@GreshamSmith.com
Office: 904.239.4536

Thank you!
Questions?

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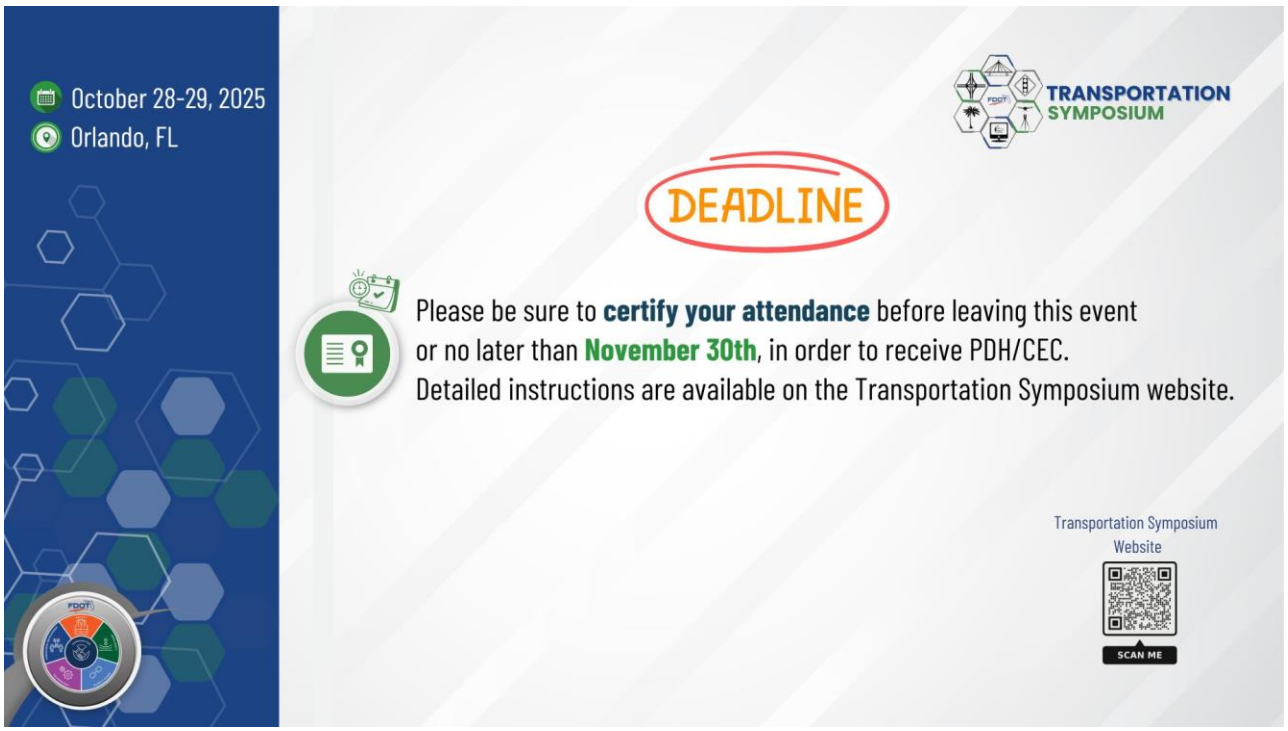

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