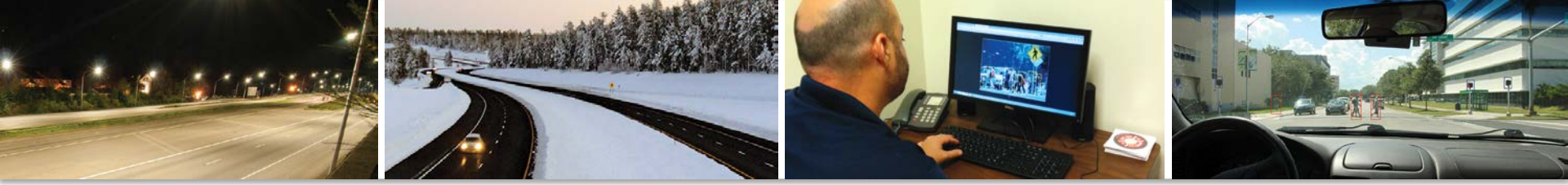


SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Concept to Countermeasure – Research to Deployment Using the SHRP2 Safety Databases

Florida: Driver Interactions with Pedestrian Features at Signalized Intersections

Stephen L. Benson, AICP, CNU-A

September 3, 2015

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Naturalistic Driving Study: Driver Interactions with Pedestrian Features at Signalized Intersections

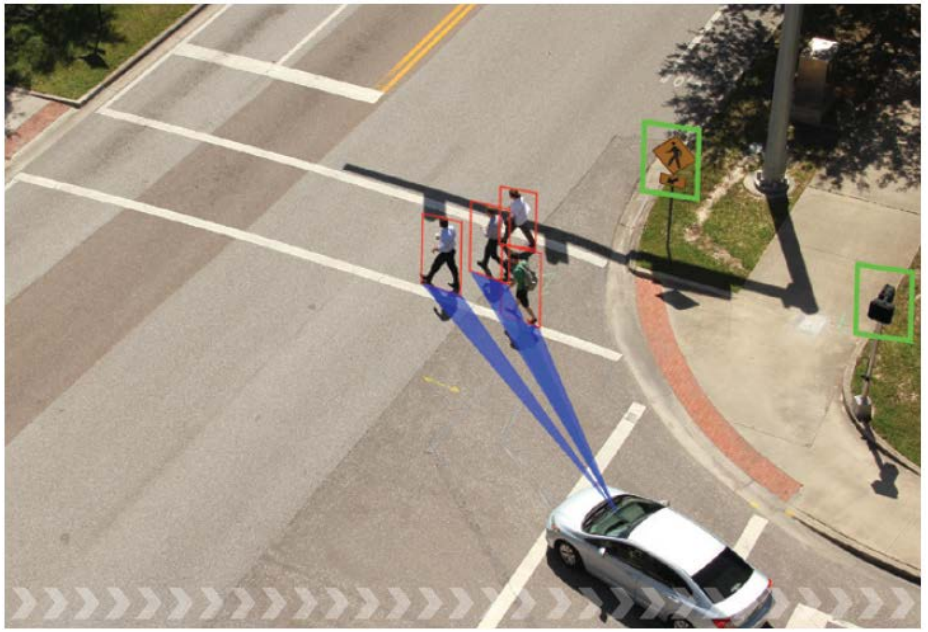
Goal for Phase1:

Develop a repeatable method that fully explores and understands the interaction of driver with pedestrian features at signalized intersections.

Centennial FDOT 1915 ★ 2015

CUTR CENTER for URBAN TRANSPORTATION RESEARCH

USF UNIVERSITY OF SOUTH FLORIDA



SHRP2 Ongoing Safety Projects

Pedestrian	Florida DOT Nevada DOT New York State DOT
Roadway Departure	Iowa DOT
Speeding	Michigan DOT Washington DOT
Work Zones	Minnesota DOT
Horizontal & Vertical Curves	North Carolina DOT
Interchange Ramps	Utah DOT
Adverse Conditions	Wyoming DOT
Roadway Lighting	Washington DOT

Pedestrian Crashes in Florida

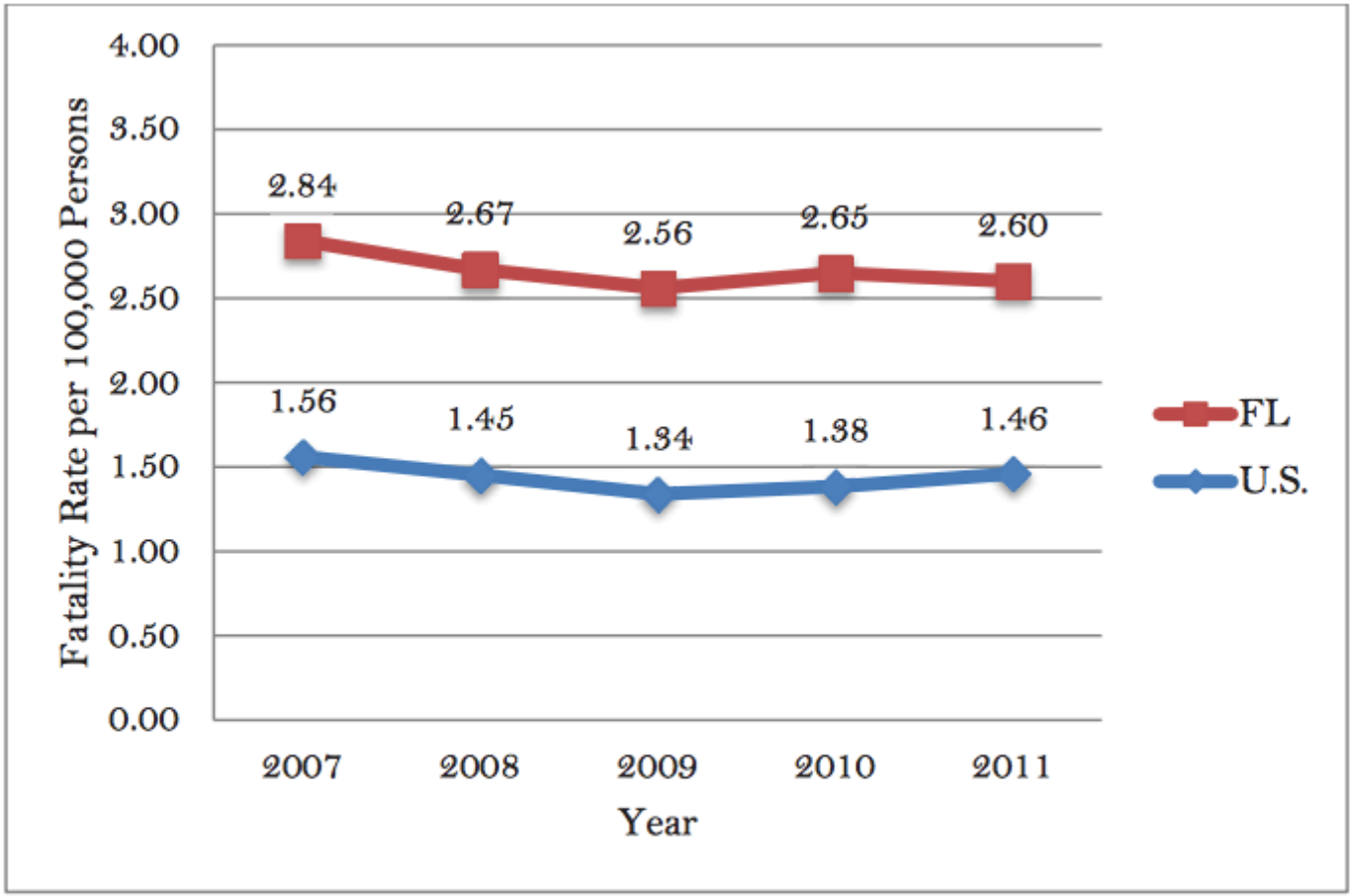


Figure 1-1. Pedestrian fatality rates per 100,000 persons.

Source: NHTSA FARS.

Pedestrian Crashes in Florida

Smart Growth America
Making Neighborhoods Great Together

National Complete Streets Coalition

TABLE 1

Large metro areas, ranked by Pedestrian Danger Index

Rank	Metropolitan area	Total pedestrian deaths (2003–2012)	Annual pedestrian deaths per 100,000 (2008–2012)	Percent of people commuting by foot (2008–2012)	Pedestrian Danger Index (2008–2012)
1	Orlando-Kissimmee, FL	583	2.75	1.1	**244.28**
2	Tampa-St. Petersburg-Clearwater, FL	874	2.97	1.6	**190.13**
3	Jacksonville, FL	359	2.48	1.4	**182.71**
4	Miami-Fort Lauderdale-Pompano Beach, FL	1,539	2.58	1.8	**145.33**
5	Memphis, TN-MS-AR	239	1.72	1.3	**131.26**
6	Birmingham-Hoover, AL*	148	1.33	1.1	**125.60**
7	Houston-Sugar Land-Baytown, TX	1,034	1.70	1.4	**119.64**
8	Atlanta-Sandy Springs-Marietta, GA	839	1.59	1.3	**119.35**
9	Phoenix-Mesa-Scottsdale, AZ	840	1.86	1.6	**118.64**
10	Charlotte-Gastonia-Concord, NC-SC	254	1.65	1.5	**111.74**

Pedestrian Crashes in Florida

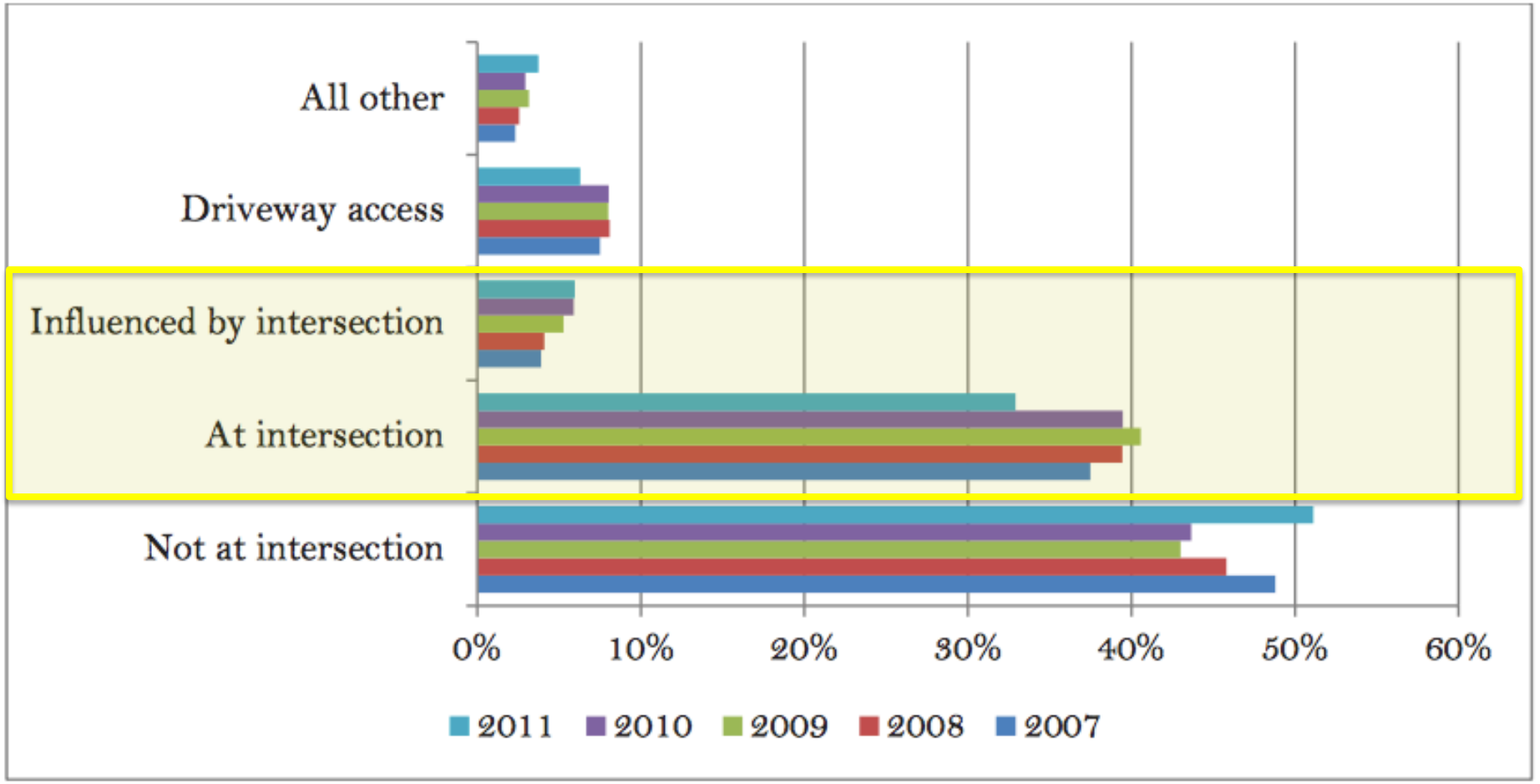


Figure 2-8. Statewide pedestrian crashes by site location.

Source: FDOT CAR System.

Research Questions

1) What are the driver interactions with different pedestrian features at signalized intersections?
2) What is the effectiveness of a specific pedestrian feature?
3) Will drivers interact with pedestrian features differently when pedestrians are present?
4) What are the impacts of driver characteristics such as gender and age group on driver interactions?

Data Acquisition- Phase I

- The Event dataset has been reviewed (crashes and near crashes) to assess established interactions.
- A series of behavioral structures has identified potential interactions in the video and sensor data.
- Combined automatically recorded and manually identified conflict information will be used in the analysis.

Summary of Data Sample

- 5 types of features to be evaluated
- 15 selected intersections
  (3 sites per feature: 2 samples & 1 control)
- 54 drivers per intersection
- 50 video traversals through each intersection, per driver

- 2,700 videos in total
  - 30 second clips (20 seconds before, 10 seconds after)
  - 10% will be full trip (to measure behavior consistency)

Detecting Presence of Pedestrian

- There were 13 conflicts with pedestrians and 8 with bicycles pre-identified in the Florida data.
- This study has identified additional instances of conflict or near-conflict in the available data.
- Less than 100 of the 2,700 videos were flagged.

Progress Report

- NDS short & long videos acquired from VTTI
- Videos reviewed & data extracted using custom tool developed by CUTR research team.
- Pedestrian detection algorithm is being trained & refined in order to increase detection rate.
- Traffic signal indication detection algorithm has been developed.

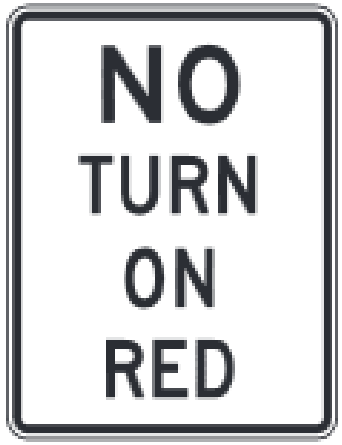
Five Features being Evaluated

1. Stop Here on Red (R10-6, R10-6a)
2. **No Turn on Red (R10-11, R10-11a, R10-11b)**
3. Turning Vehicles Yield to Pedestrians (R10-15)
4. **Right on Red Arrow After Stop (R10-17a)**
5. Permissive-only left turn signal phasing

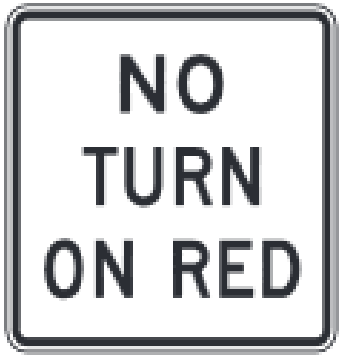
Feature 2

“NO TURN ON RED” SIGN

R10-11



R10-11a

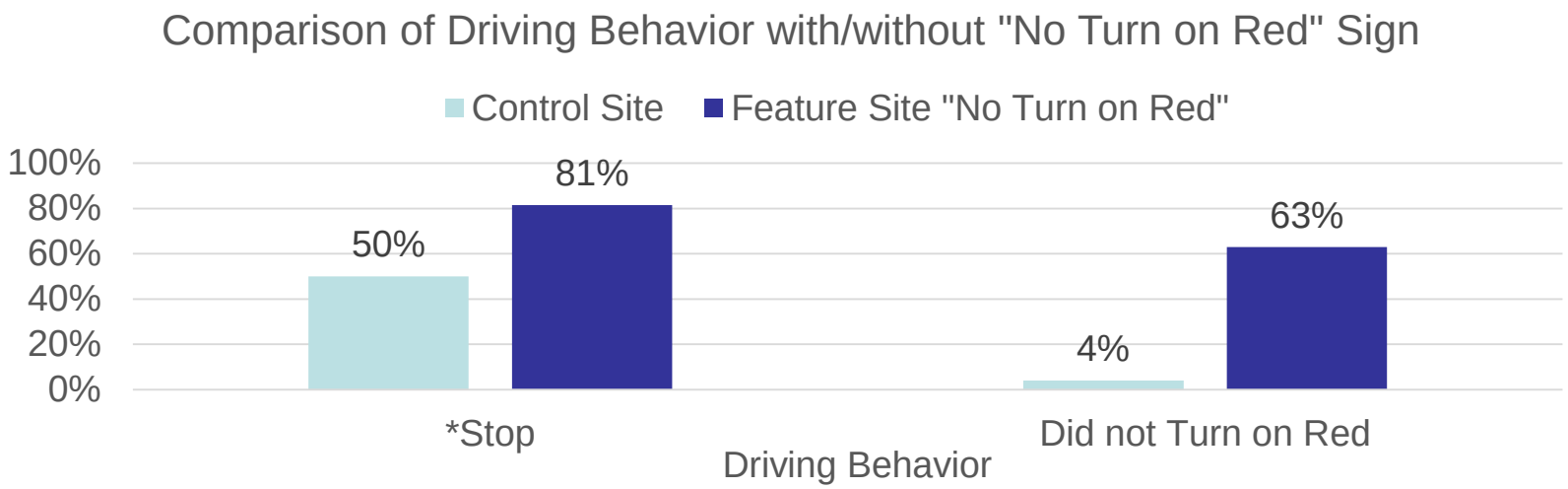


R10-11b

NO TURN ON RED shall be used to prohibit a right turn on red (Millennium MUTCD)

Complied with the feature sign = did not turn on red

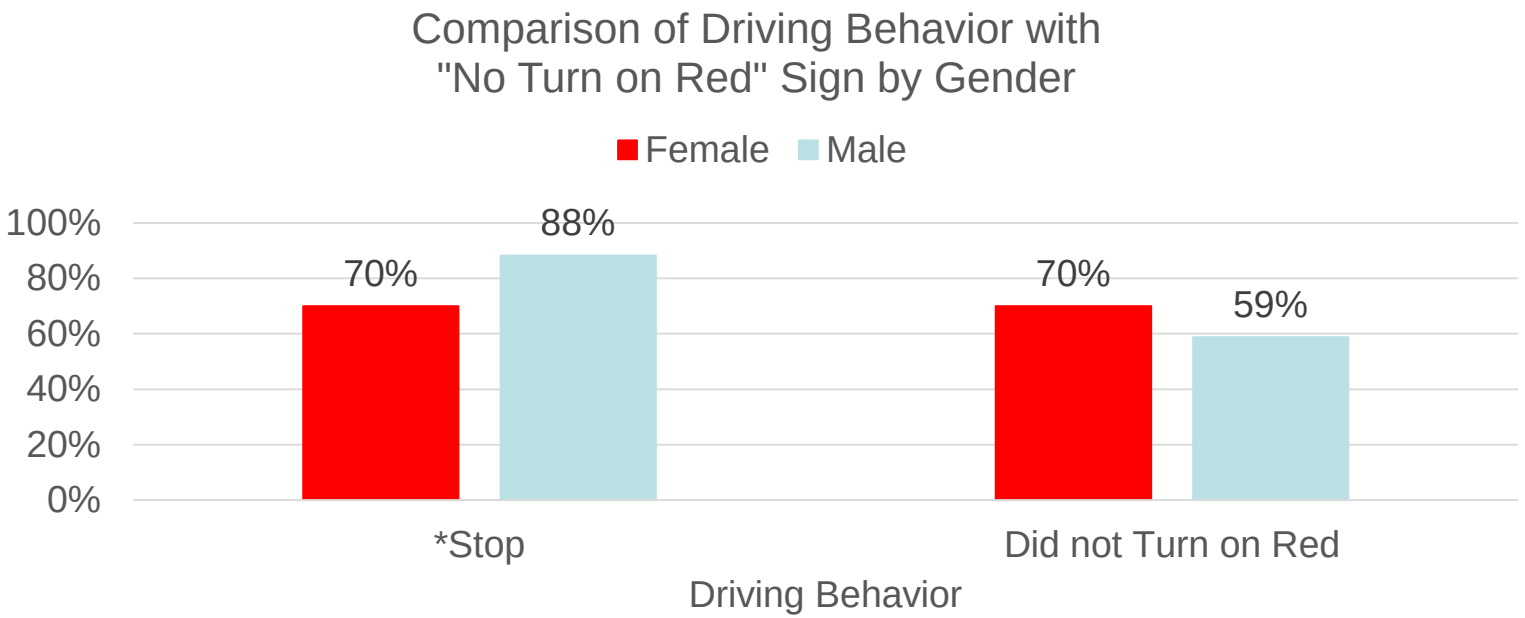
Feature 2: Overall Effectiveness



*Stop: stop-turn, stop-observe-turn, and stop-wait (no turn on red)

- Drivers who encountered the feature sign were more likely to stop on red: **81%** vs. **50%**
- Feature sign significantly generated a **63%** compliance rate at the posted locations.

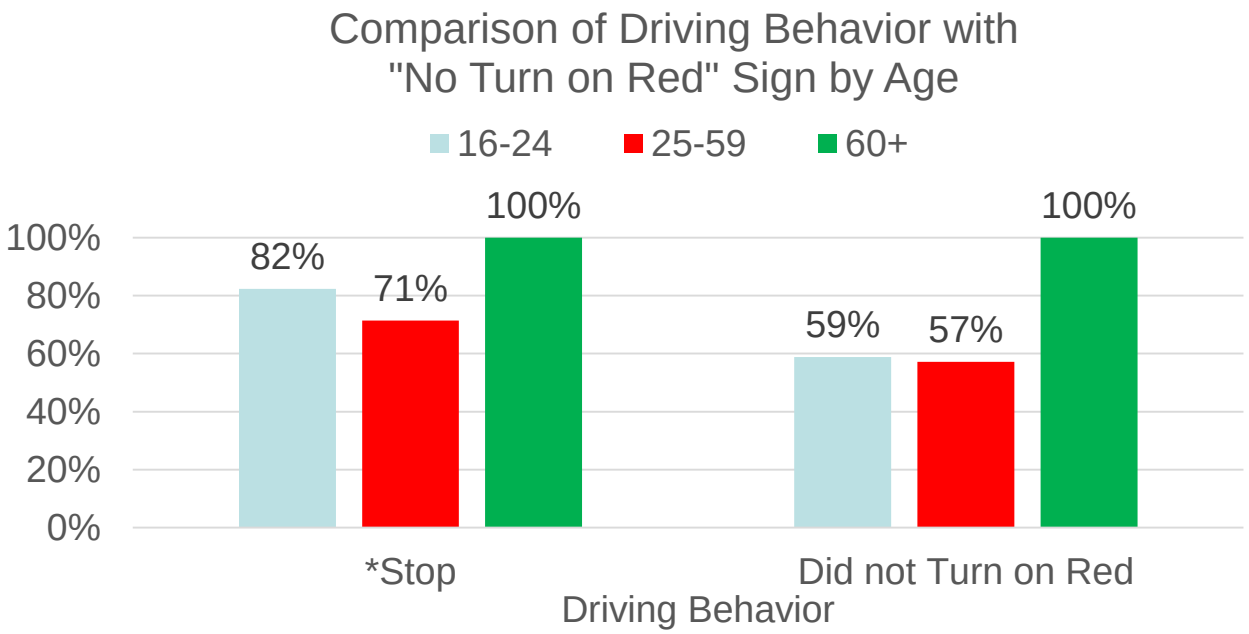
Feature 2: Driver Behavior by Gender



*Stop: stop-turn, stop-observe-turn, and stop-wait (no turn on red)

- Male drivers are more likely to stop on red: 88% vs. 70%
- Female drivers are more likely to comply with feature sign: 70% vs. 59%

Feature 2: Driver Behavior by Age



*Stop: stop-turn, stop-observe-turn, and stop-wait (no turn on red)

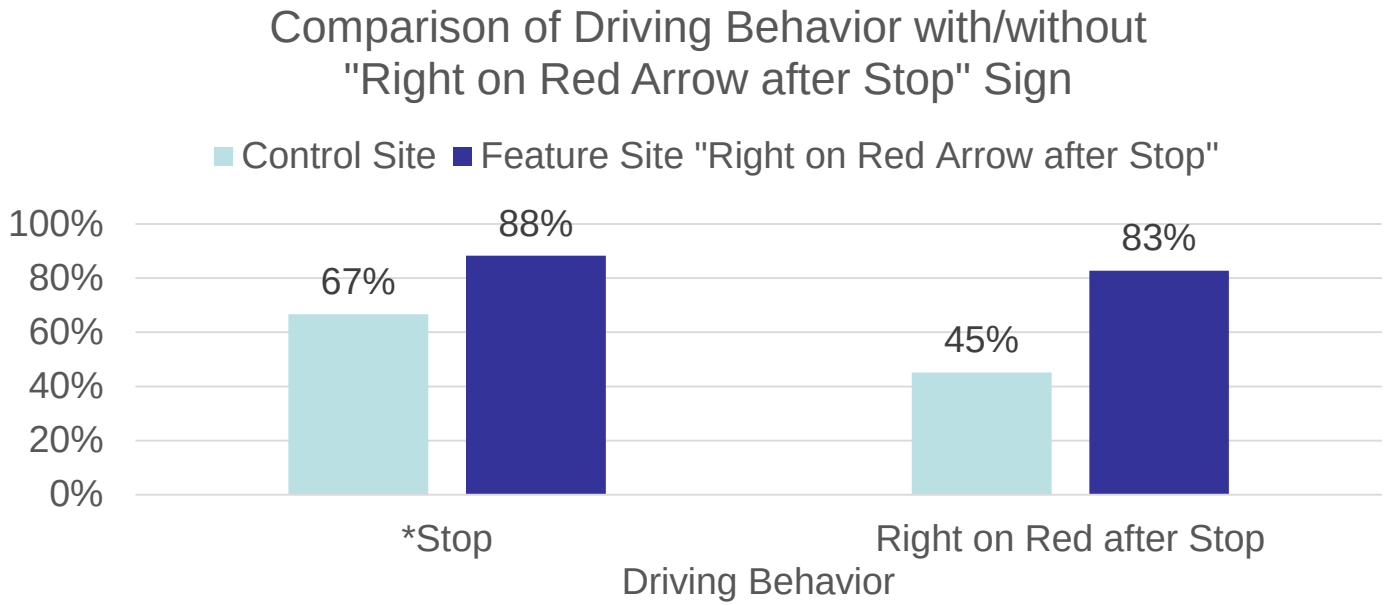
- 60+ drivers are sensitive to the feature sign: 100% comply with the feature sign
- 16-24 drivers are more likely to comply than the 25-59 drivers

Feature 4

“RIGHT ON RED ARROW AFTER STOP” SIGN (R10-17A)

- Right on Red Arrow After Stop leads to safer driving by forcing motorists to stop first before turning right
- Complied with the feature sign = stop-observe-turn or stop-wait

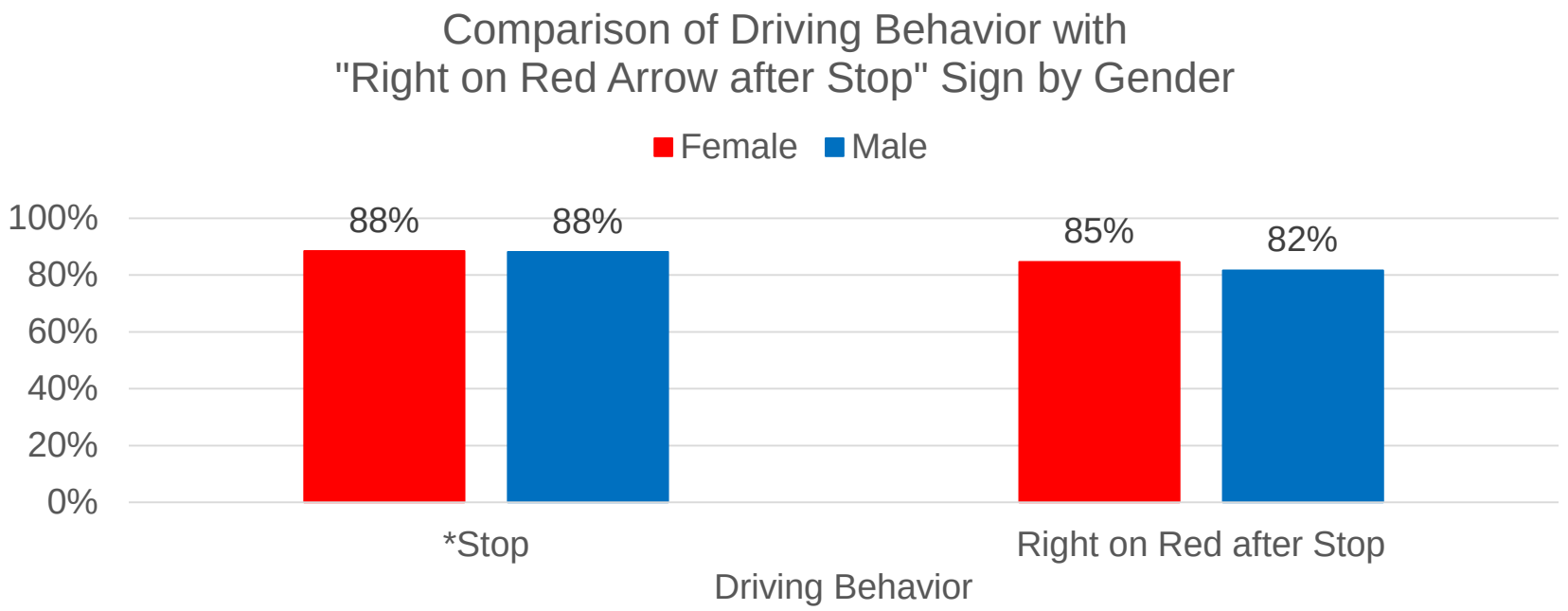
Feature 4: Overall Effectiveness



*Stop: stop-turn, stop-observe-turn, and stop-wait

- Compared to the control site, drivers with feature sign were more likely to comply red: 88% vs. 67%
- Compared to the control site, drivers with the feature sign are more likely to Stop-Observe-Turn on Red: 83% vs. 45%

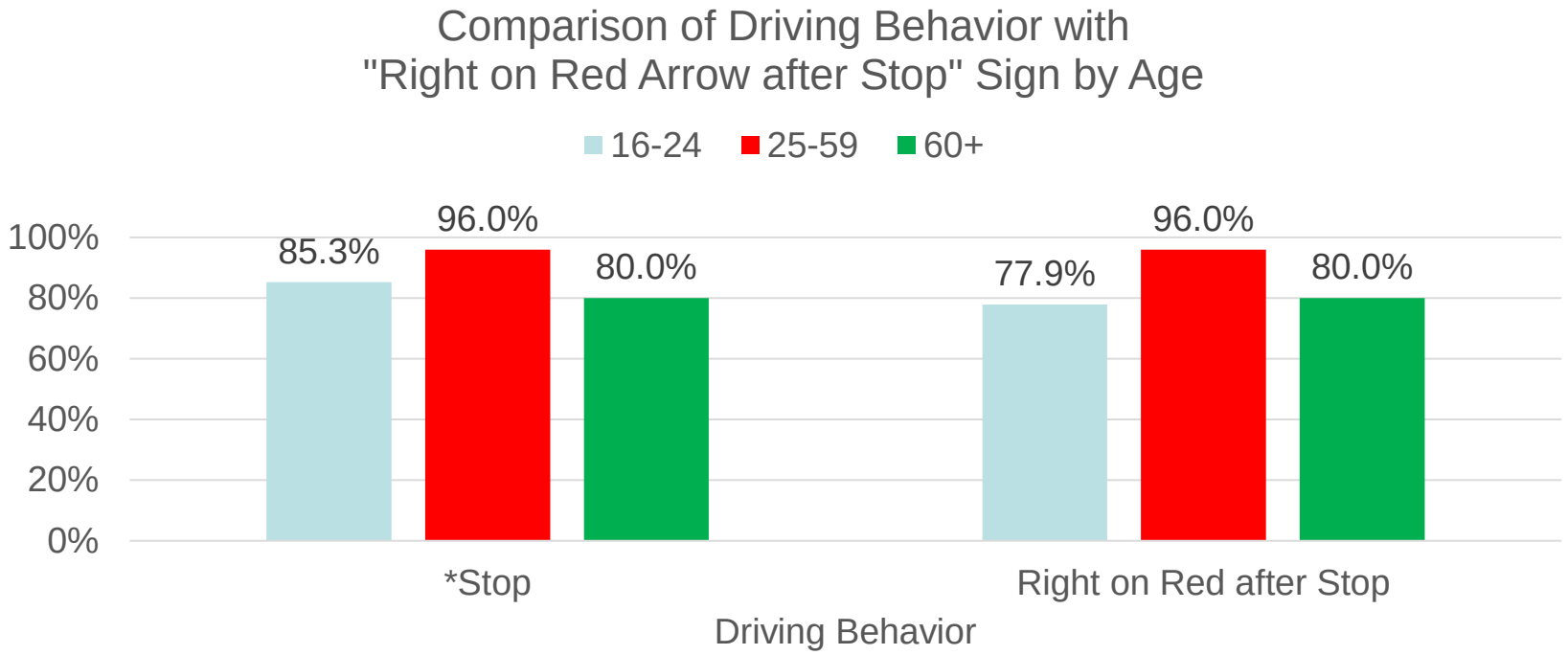
Feature 4: Driver Behavior by Gender



*Stop: stop-turn, stop-observe-turn, and stop-wait

Female drivers are more likely to comply with the feature sign than male drivers: 85% vs. 82%

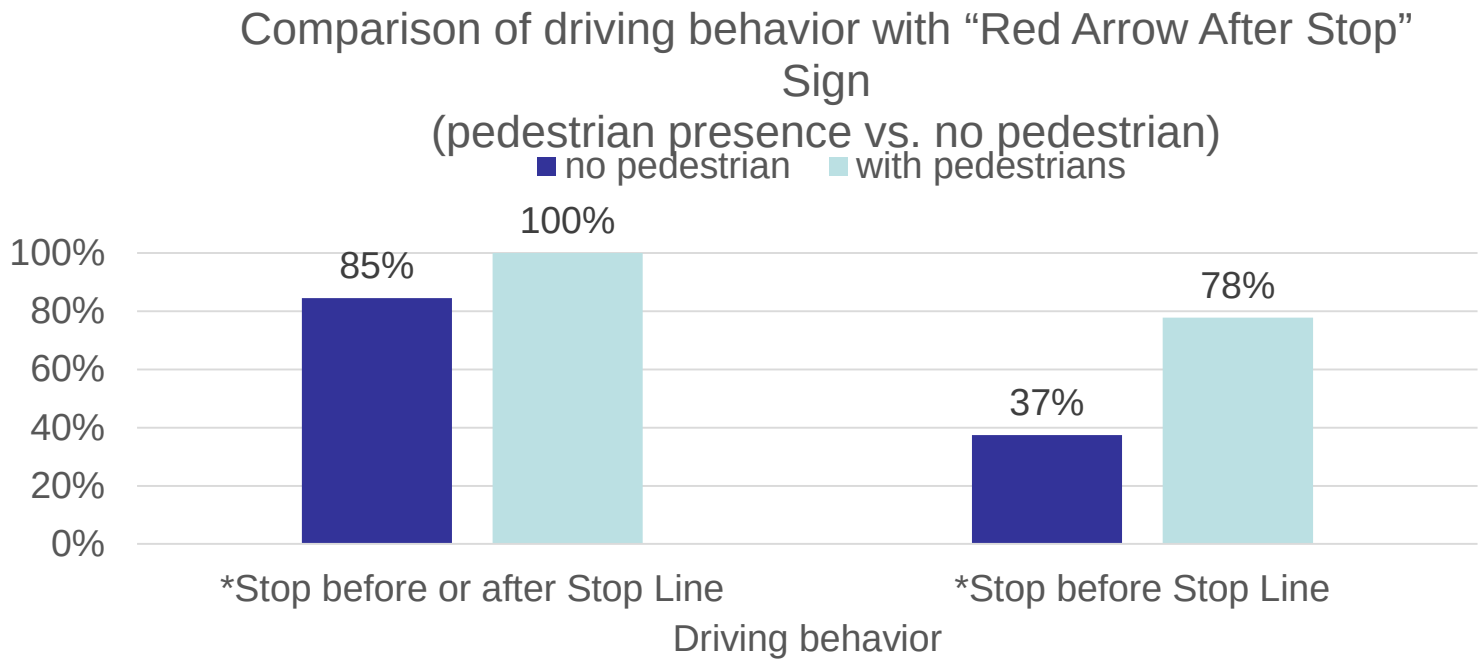
Feature 4: Driver Behavior by Age



*Stop: stop-turn, stop-observe-turn, and stop-wait

- 25-59 drivers are more likely to comply with the feature sign, followed by 60+ drivers and 16-24 drivers, respectively

Feature 4: Driver behavior by Pedestrian Presence



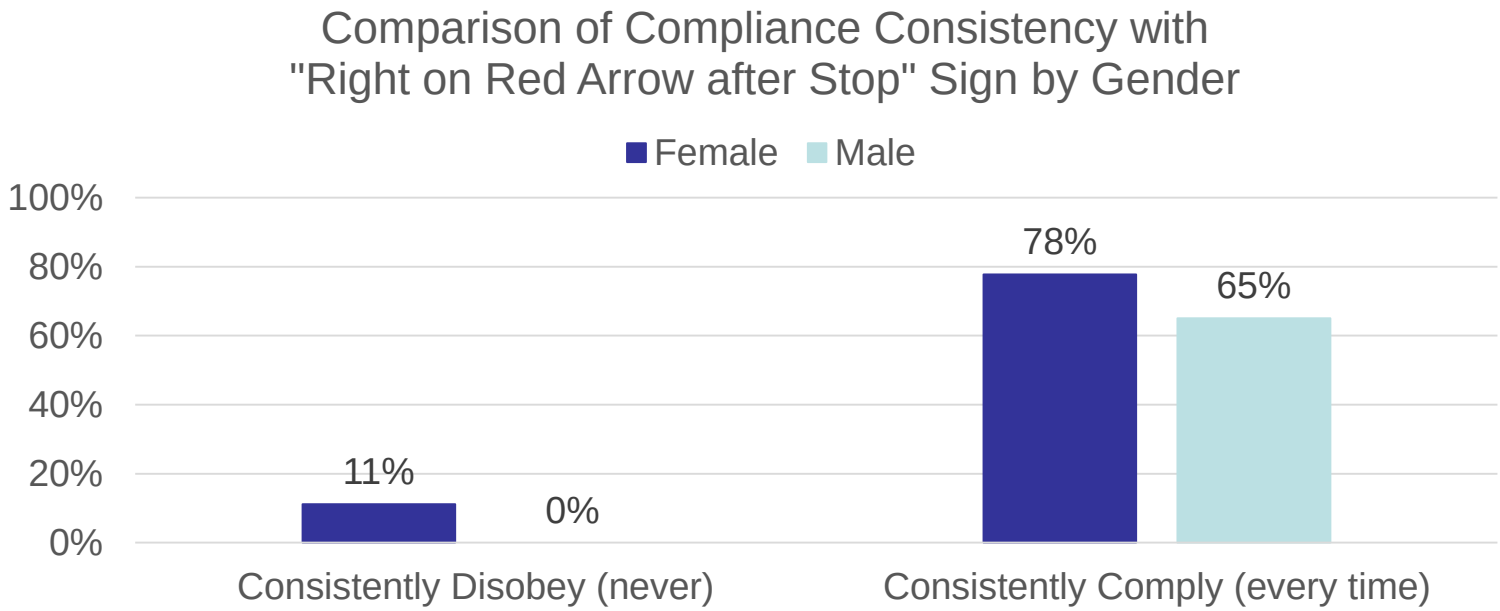
*Stop: stop-turn, stop-observe-turn, and stop-wait
*Based on stopping position, stop includes “stop before stop line” and “stop after stop line”

Drivers who encounter the feature sign are more likely to stop before the stop bar when a pedestrian is present: **78%** vs. **37%**

Compliance consistency of drivers

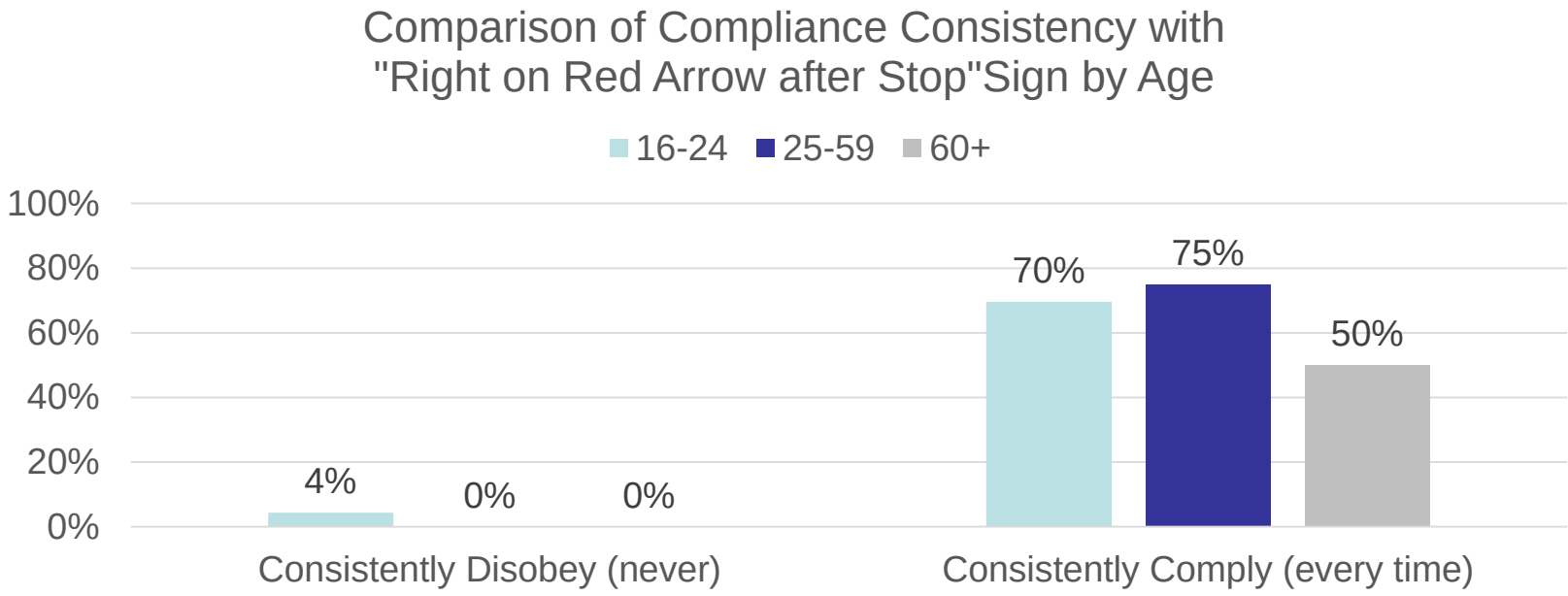
- Does the same driver interact with the same feature sign differently (consistently comply or not)?
- Does the same driver interact with different feature signs differently (comply with both or not)?

Feature 4: Compliance consistency by Gender



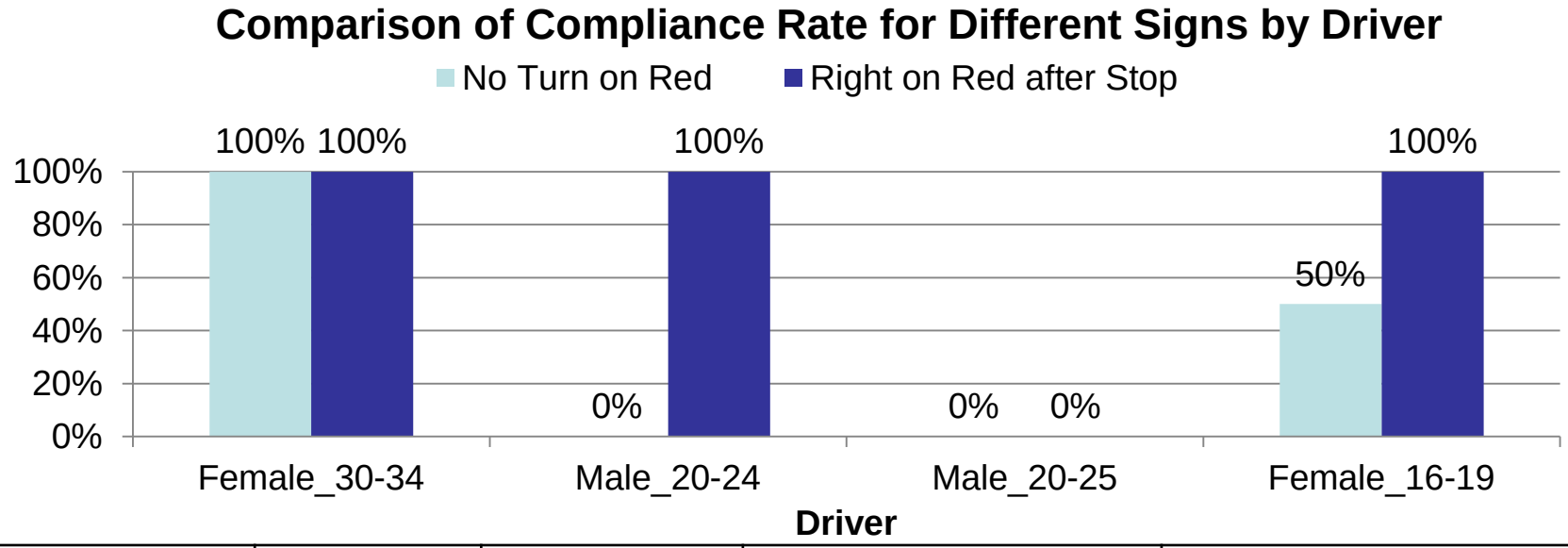
- Female drivers are more likely to consistently comply with the feature sign than male drivers: 78% vs. 65%
- Female drivers are also more likely to consistently disobey with than male drivers: 11% vs. 0%

Feature 4: Compliance consistency by Gender



- 25-59 drivers more likely to consistently comply with the feature sign, followed by 16-24 drivers and 60+ drivers, respectively: 75% ,*70%, *50%
  - *Small sample size
- 16-24 drivers are more likely to consistently disobey the feature sign than other drivers: 4% vs. 0%

Driver compliance across different features



PARTICIPANT_ID	Gender	Age Group	No Turn on Red		Right on Red after Stop	
			Not Comply	Comply	Not Comply	Comply
105421	F	30-34		2		1
117163	M	20-24	2			3
565497	M	20-24	1		1	
868437	F	16-19	1	1		1

- Driver 1 complied with both signs; driver 2 complied with “Right on Red after Stop” sign; driver 3 did not comply with any sign; driver 4 did not consistently comply
- With larger sample size, more interesting patterns can be revealed by gender, age etc.

Progress Report

- Data is being analyzed based on proposed research questions on specific pedestrian features at selected signalized intersections.
- Currently finalizing summary report for submittal.

Project completion date - September 30, 2015

Questions?

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