Using NDS Data to Evaluate Senior Driver Behavior at Intersections

**Third International Symposium on
Naturalistic Driving Research
August 27 — 30, 2012
Blacksburg, Virginia**

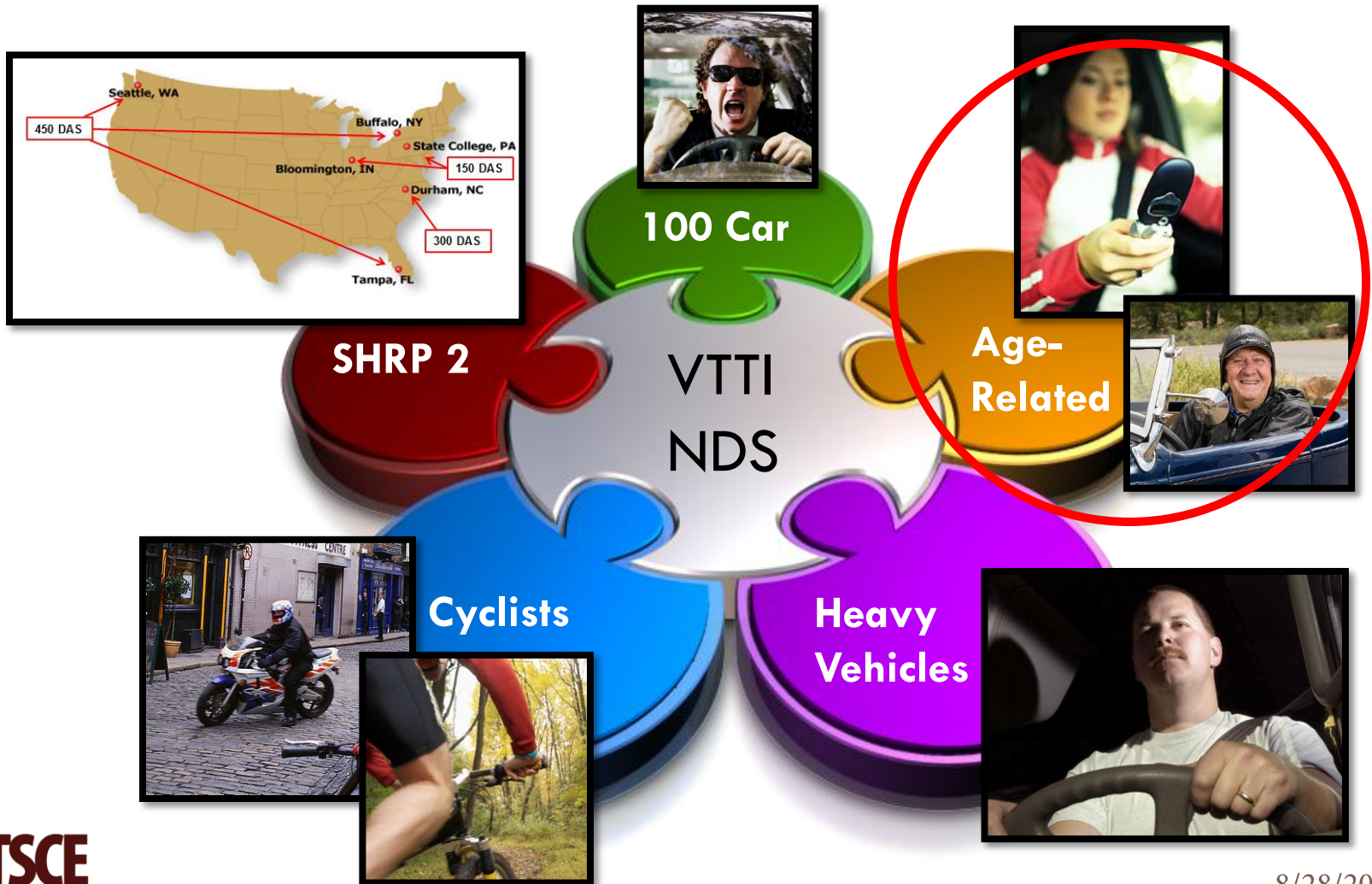# Using NDS Data to Evaluate Senior Driver Behavior at Intersections

Sponsors of Work Reported

- National Surface Transportation Safety Center for Excellence (NSTSCE)
- Toyota Technical Center
- National Institutes of Health

Overview of NDS at VTTI

SHRP 2

100 Car

Age-Related

VTTI NDS

Cyclists

Heavy Vehicles

8/28/2012

Overview

- **Study I** – Investigate the relative risk of purportedly high demand driving situations for older drivers using naturalistic driving data

- **Study II** – Based on results of Study I, compare lateral head rotations of middle-aged and older drivers at intersections using naturalistic driving data

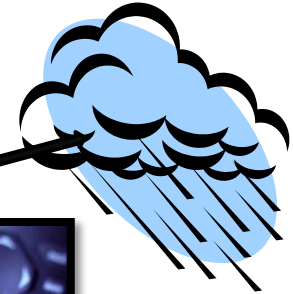# Which driving situations impose high demand on older drivers?
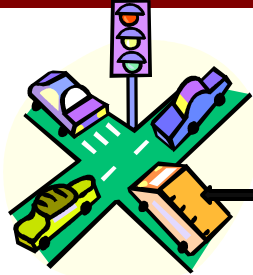
- intersections
- navigation
- merging
- inclement weather
- night driving
- nomadic device use
- various roadway and environ. factors

NSTSCE
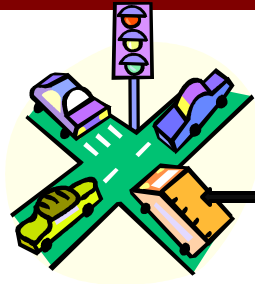National Surface Transportation
Safety Center for Excellence

Senior Naturalistic Driving Study Overview

- 20 Primary Drivers
  - 11 male, 9 female
  - 71-84 years of age
- One year per participant
- Continuous data collection
- 4 camera views
- Multiple sensors (accelerometers, GPS, radar, vehicle network)
- Total Trip Data Files: 29,172
- Total Data Hours: ≈ 4,639

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Crash / Near-Crash Analysis

Older Driver High Demand Situations

- Intersections
- Merging

Table 6. Odds Ratios for High Demand Driving Situations for Elderly Drivers

High Driving Demand Factor for Older Drivers	Point Estimate	Lower CI	Upper CI
Intersections	4.18	2.65	6.61
Merging	2.51	1.15	5.47

Table 7. Odds Ratios for High Demand Driving Situations for Elderly Drivers (at fault crashes only)

High Driving Demand Factor for Older Drivers	Point Estimate	Lower CI	Upper CI
Intersections	3.42	2.00	5.83
Merging	2.53	1.04	6.13

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Study II – Range of Head Rotation at Intersections

- Literature review & Study I showed / confirmed intersections represent one of the most difficult and risky driving scenario for older drivers

- Studies have shown narrower *glance patterns* for older drivers in certain driving situations

- Goal – Investigate lateral head rotation behaviors for intersection crossings for older and middle-aged drivers

- Follow-on to pilot study by Angell, Antin, Wotring, and Aich (2010)

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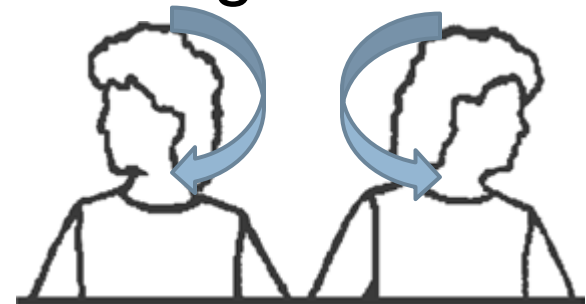
Key Results

Range of Lateral Head Rotation (Yaw)
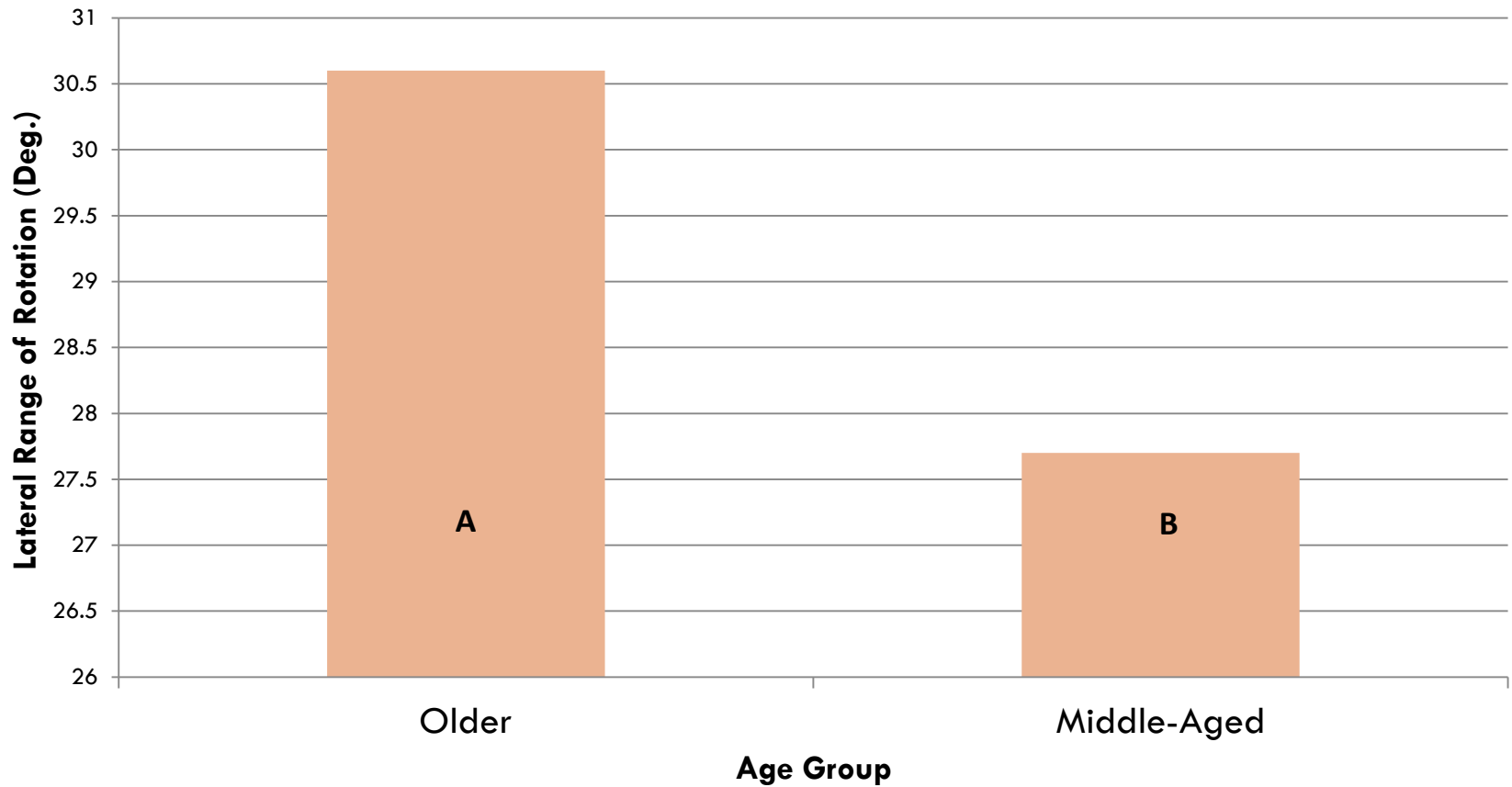
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Counterintuitive Result? Compensation?

Older Useful Field of View

Middle-Aged Useful Field of View

180° — 0°

Older Drivers

Middle-Aged Drivers

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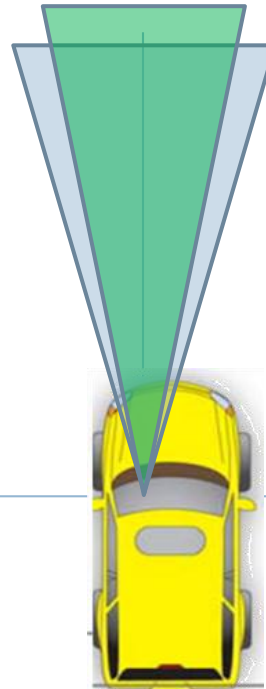
Further Studies of Age-Related Intersection Behavior

Sudipto Aich and Linda Angell
VTTI

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How do drivers regulate their visual glances while making unprotected turns?

– **Visual Entropy**

Using Visual Glance Reduction for each location, probability (P_i)of each location is computed

Entropy = H = $\sum P_i log_2 (^1/_{P_i})$, Source: Shannon, 1948

Where:

- P = Probability of glance to a particular location
- i = a particular location
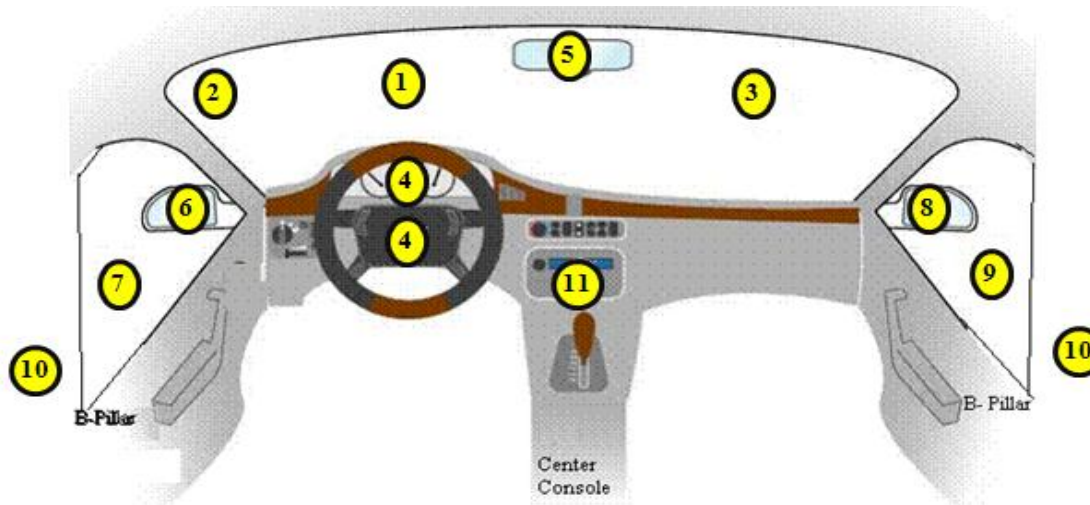
Analysis: Significant Differences
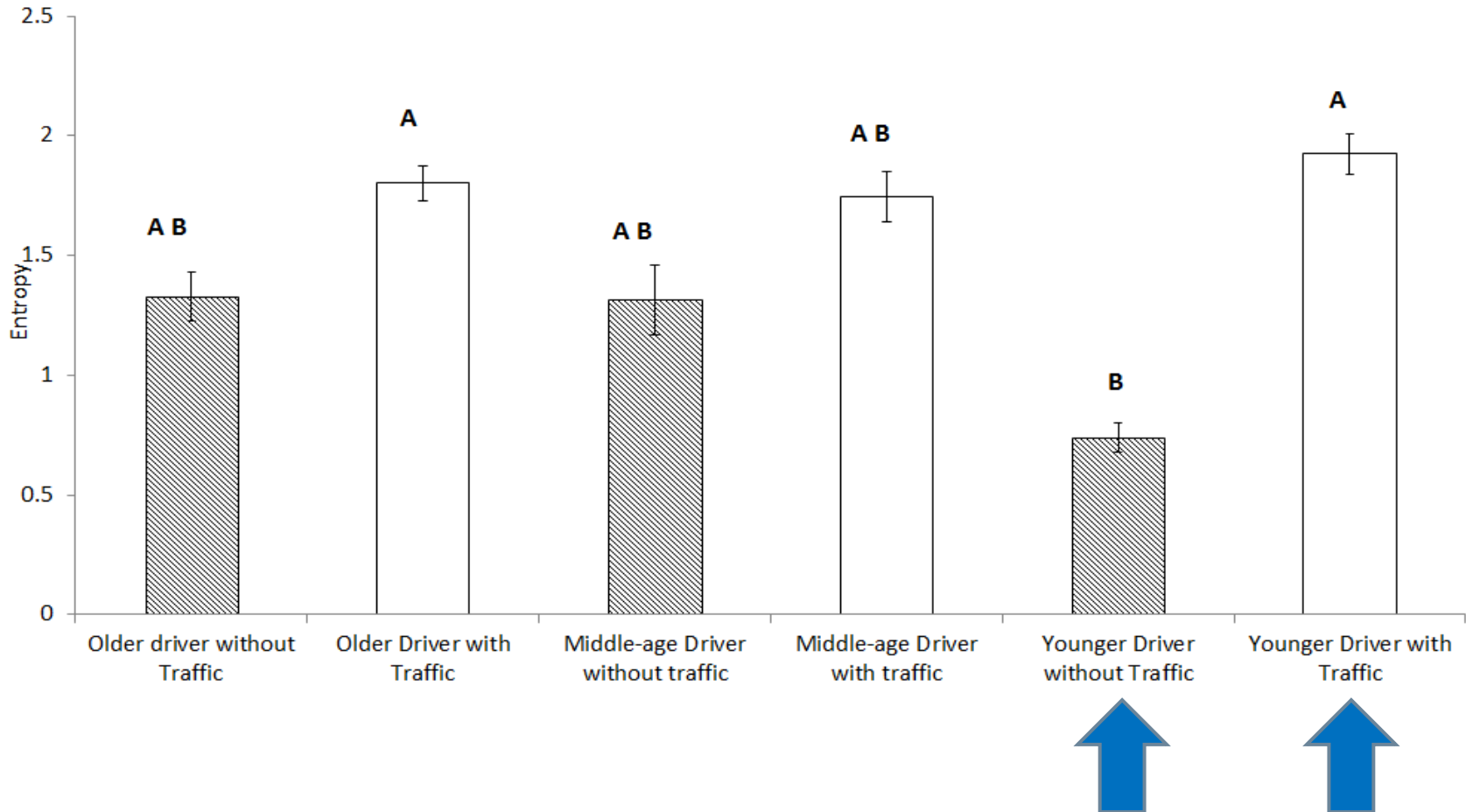
Analysis: Significant Differences
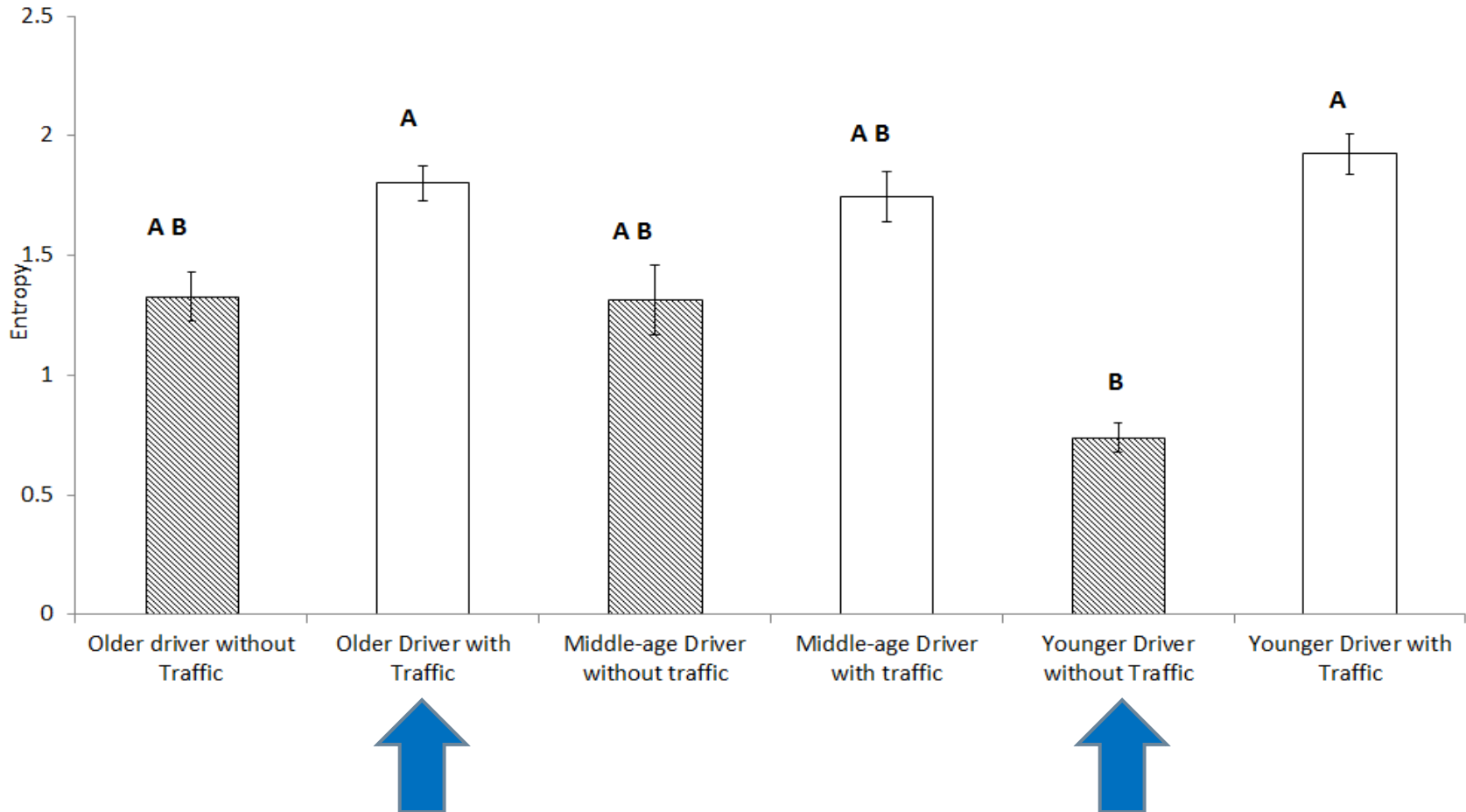
Analysis: *Not* Significant Differences
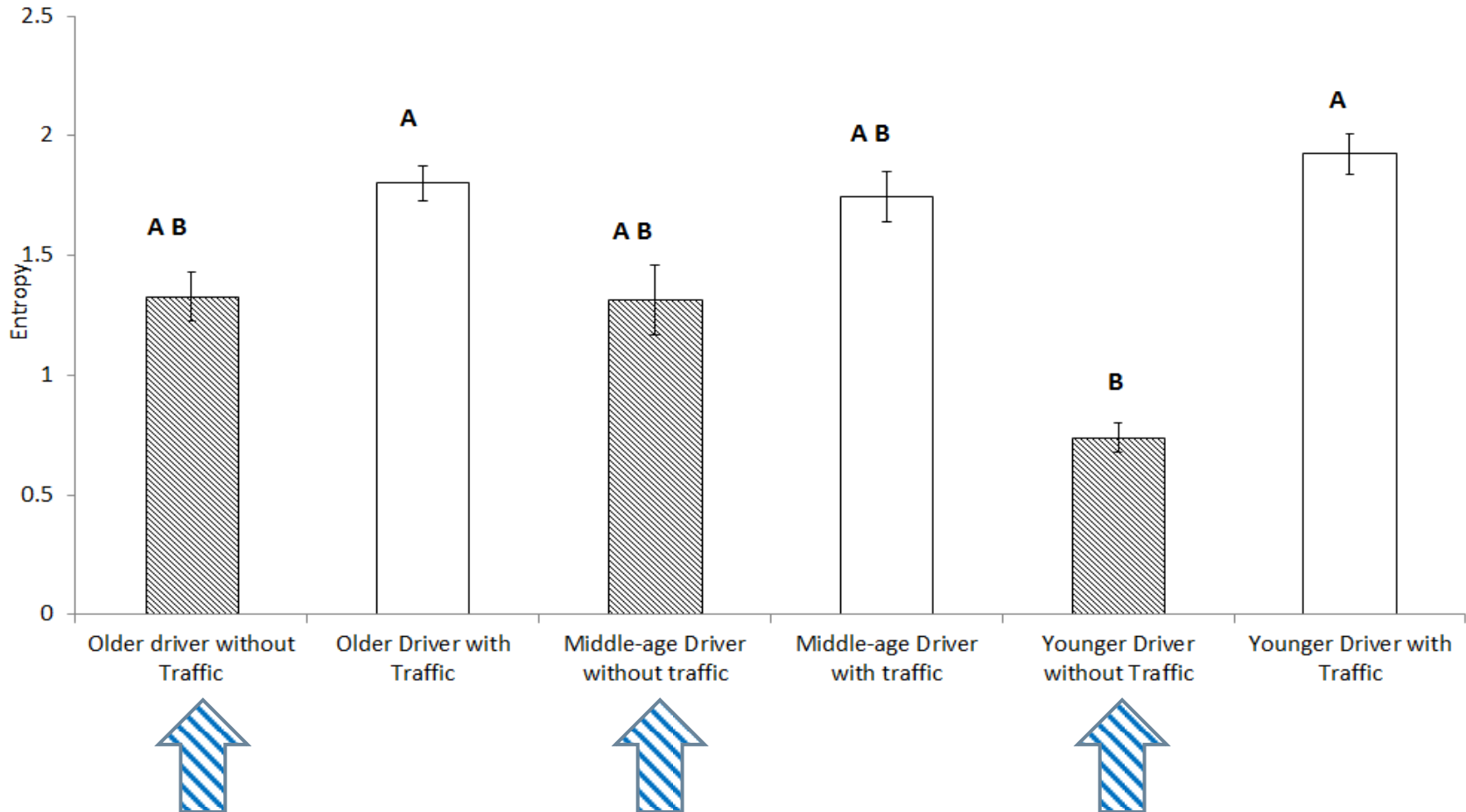
Glance Distribution by Location

Older Driver Left Turn
- Other 3%
- Right Windshield 6%
- Left Windshield 1%
- Left Window 16%
- Forward 48%
- Right Window 26%
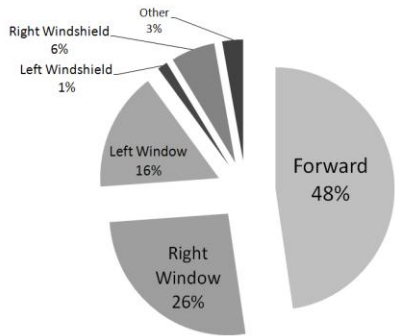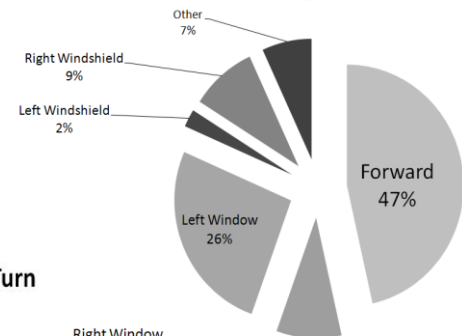
Middle Age Driver Left Turn
- Other 10%
- ...hield 3%
- Left Windshield 1%
- Left Window 17%
- Forward 56%
- Right Window 13%

Younger Driver Left Turn
- Other 9%
- Right Windshield 6%
- Left Windshield 1%
- Left Window 17%
- Forward 53%
- Right Window 14%

Older Driver Right Turn
- Other 7%
- Right Windshield 9%
- Left Windshield 2%
- Forward 47%
- Left Window 26%
- Right Window 9%

Middle Age Driver Right Turn
- Other 7%
- Right Windshield 4%
- Left Windshield 1%
- Left Window 26%
- Forward 59%
- Right Window 3%

Younger Driver Right Turn
- Other 14%
- Right Windshield 3%
- Left Windshield 3%
- Left Window 16%
- Forward 63%
- Right Window 1%

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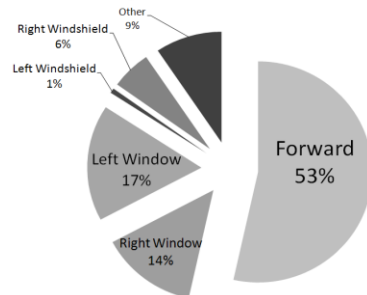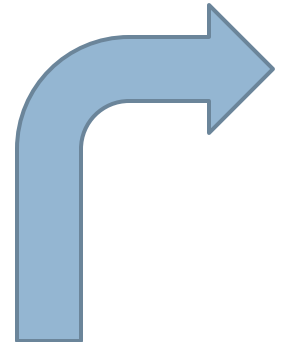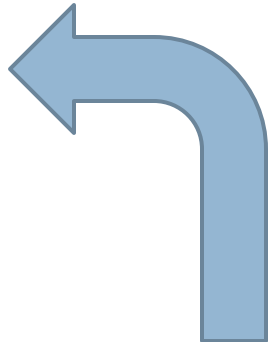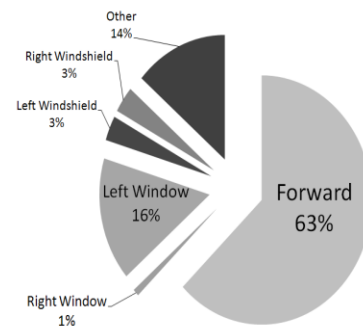
Glance Distribution by Location:
L Window + R Window

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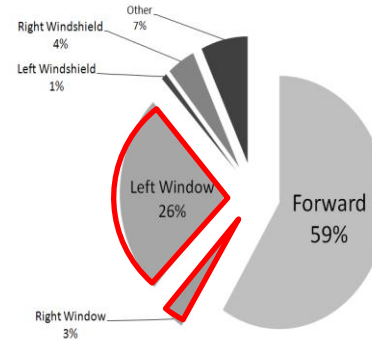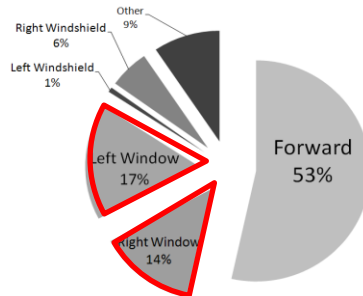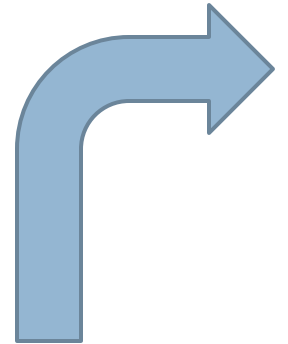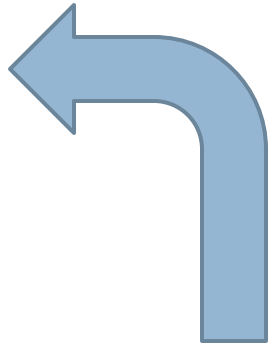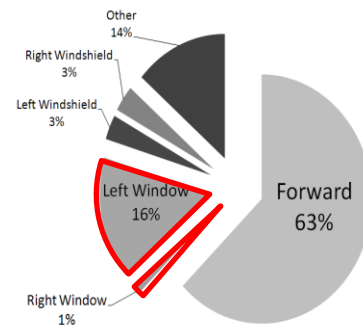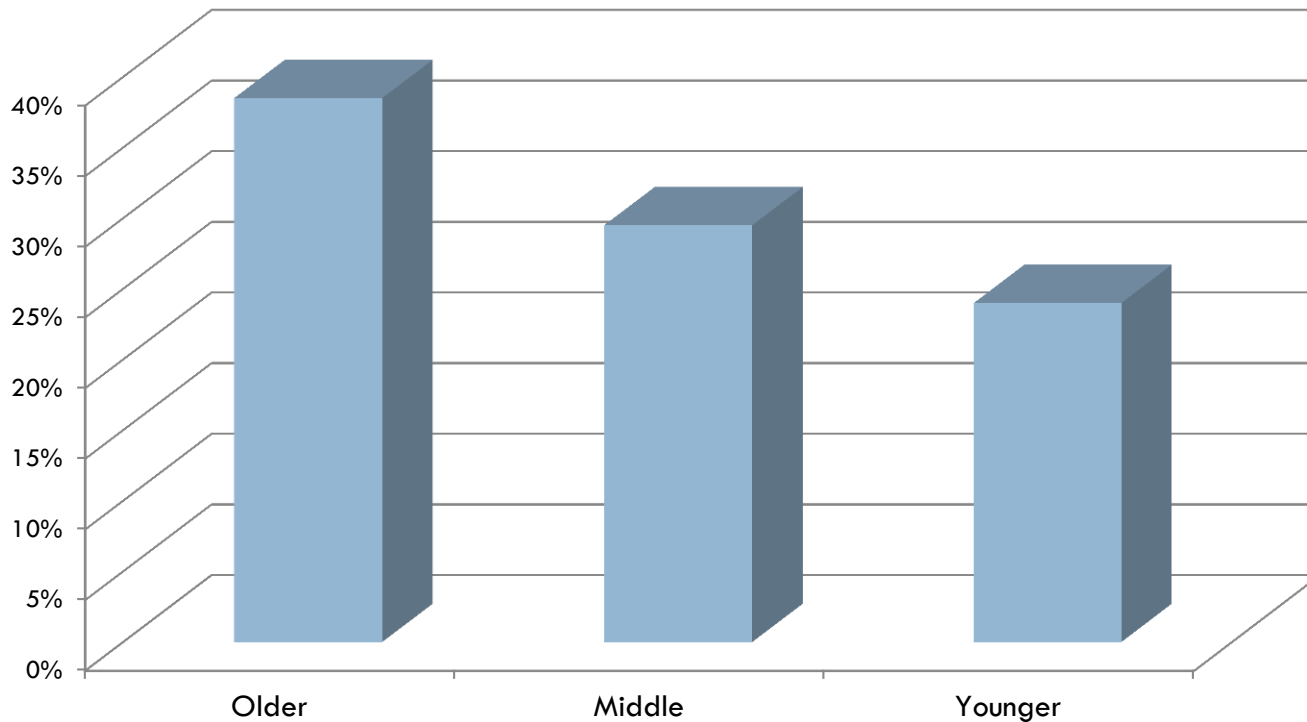
Glance Distribution by Location

Right Window + Left Window Average

Counterintuitive Result? Compensation?

Older Useful Field of View

Middle-Aged Useful Field of View

180°

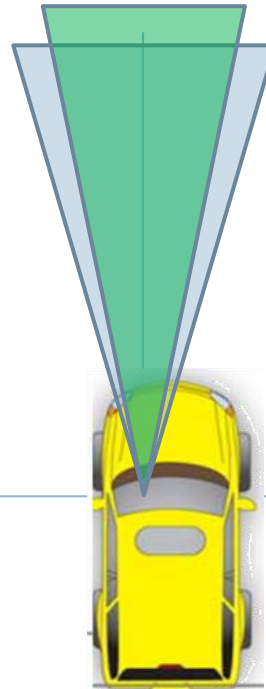0°

Older Drivers

Middle-Aged Drivers

International Comparison: U.S. and Australia

- Jude Charlton and her colleagues conducted a naturalistic study of distracted driving behavior of Australian seniors at intersections

- She and I decided it would be interesting to attempt to perform the same reductions and analyses on naturalistic driving data collected with U.S. seniors and compare the results.

- More difficult than originally imagined

International Comparison: U.S. and Australia

- Similar language and culture, but there are important differences…