

# NSTSCE

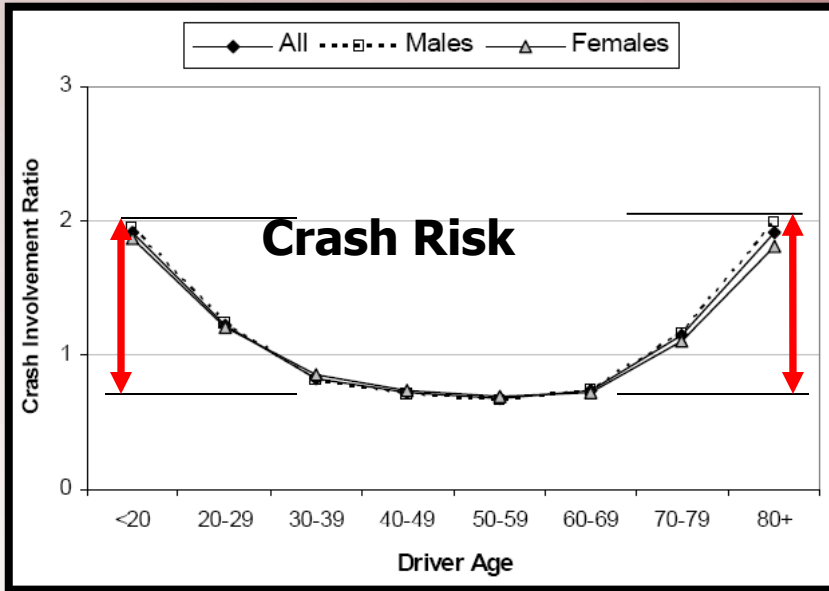
# Age-Related Driving

# Research Update

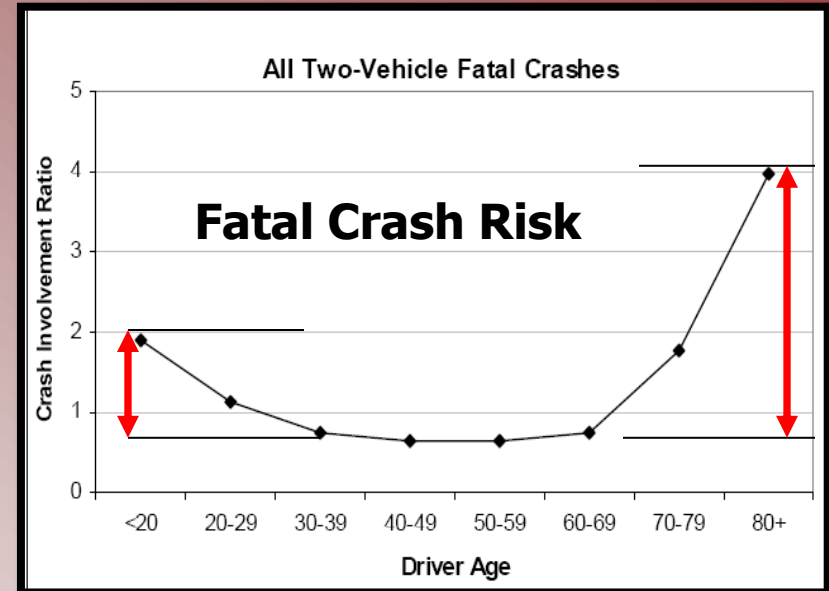
Jon Antin

Sep 1 2010

# Age-Related Problems at Both Ends of Spectrum



**Overall two-Vehicle CIRs for police-reported crashes by driver age group and gender (GES Data)**



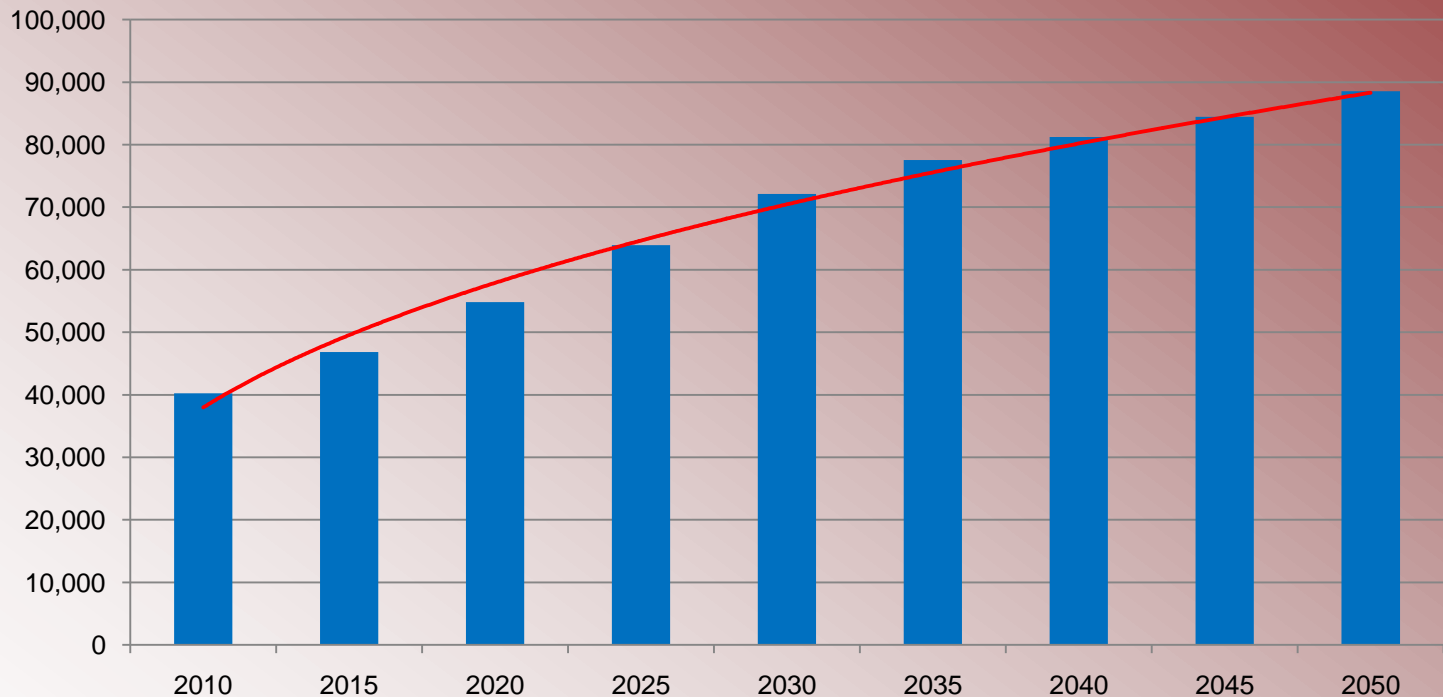
**Overall two-Vehicle fatal Crash Involvement Ratios (CIR) by driver age group (FARS data)**

From Stutts, Martell, and Staplin (2009)

# Aging Population

## Raw Numbers *and* Proportion of Total

**65+ Census Projections**  
(numbers in 1,000s)



U.S. Census Bureau (2008)

# Older Driver NDS

- Investigator: Antin
- Vehicles: 20 Privately Owned
- Age Range: (M, F: 71-84)
- Timeframe: 2008-2009
- Duration: 12 months each
- Location: New River Valley, Va
- Trip Files: 29,172
- Data Hours:  $\approx$  4,639
- Driver & Non-Driver Assessments

# Assessment Battery (2 Sessions – 2 Days)

- Driving History
- Health
  - General
  - Medications
  - Sleep Hygiene
  - Faces Pain Scale
- Visual ability
  - Acuity (Big E Chart)
  - Contrast Sensitivity
  - Color Perception
  - Depth Perception
  - Glare Sensitivity
  - Accommodation Metrics
  - Dynamic Visual Acuity

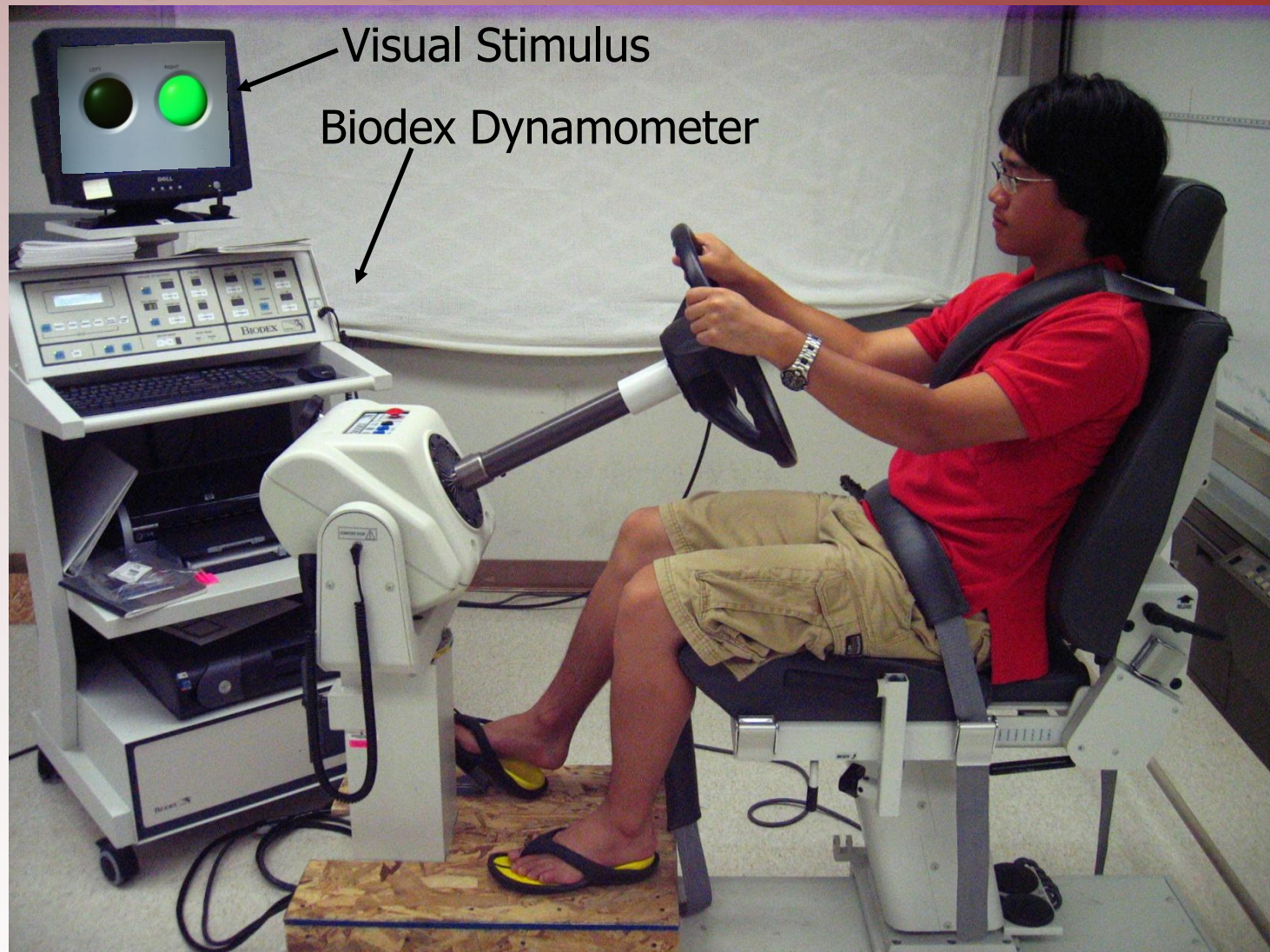
# Assessment Battery (cont.)

- Physical
  - Upper Body Strength
  - Lower Body Strength
  - Head-Neck-Torso Flexibility
- Psychomotor
  - Upper Body Reaction Time
  - Lower Body Reaction Time

# Assessment Battery (cont.)

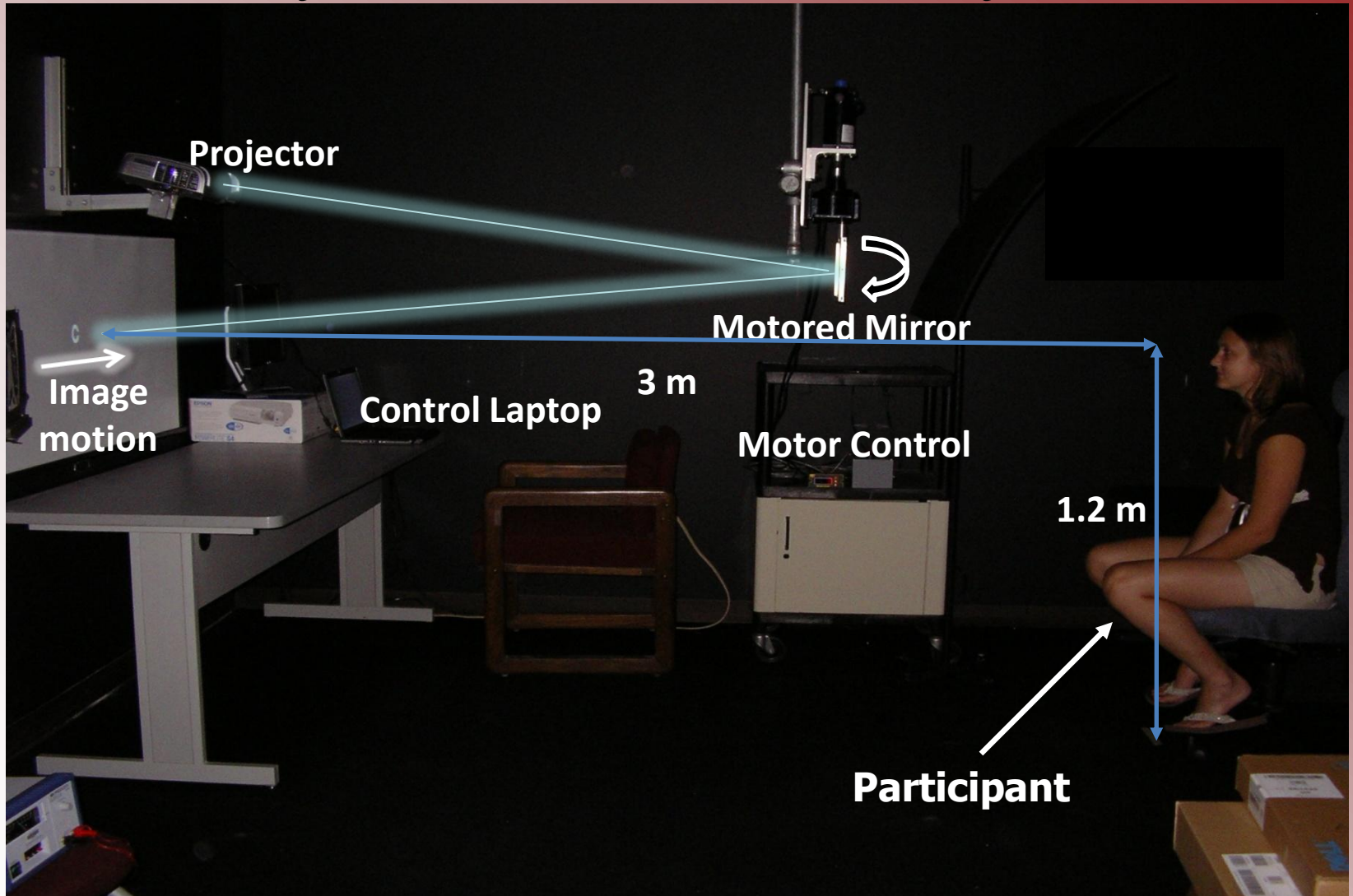
- Cognitive / Attitudinal
  - Dementia
    - Abbreviated Mental Test
  - Depression
    - WHO (Five) Well-Being Index
    - Major (ICD-10) Depression Inventory

# Upper Body Strength & Reaction Time Apparatus





# Dynamic Visual Acuity Tester



# Logistic Regression Model

- Model was highly successful at separating drivers from non drivers based on the following assessments:
  - Dynamic Visual Acuity (24 deg/s)
  - Upper Body Strength
  - Trail Making
- If we can develop a parsimonious approach & model that are:
  - based on a few easy-to-administer assessments
  - highly predictive of safety-related driving behaviors / outcomes
- Then, we may have a diagnostic tool suitable for assessing fitness to drive

# General Area Thrust

- Collect & Mine Naturalistic Data
  - Older Driver NDS
  - 40-Teen NDS (collection funded by NIH & NHTSA)
- Follow-On Efforts
  - Teen Driver Coach
- Mining Examples
  - Age-related Driver Difficulties at Intersections (meta-analysis on Older Driver and 40-Teen NDS collections)
  - Rural Hot Spots
  - Fitness to Drive modeling/validation

# Age-Related Difficulties in Left Turns



Research Team:

Linda Angell  
Jon Antin  
Brian Wotring  
Sudipto Aich

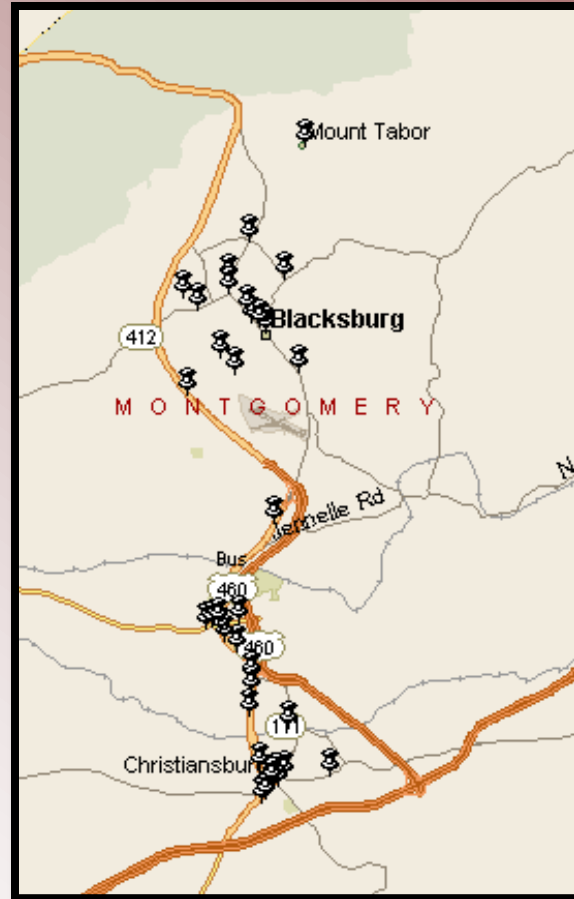
# Project Overview

- Background
  - Turns across path are generally regarded as the single most serious problem for older drivers
  - Past *experimental* research has shown differences in the scan patterns of younger and older drivers in such situations
- Primary Goal
  - Using *naturalistic data* - determine if visual scanning of older drivers at intersections shows differences from that of other drivers

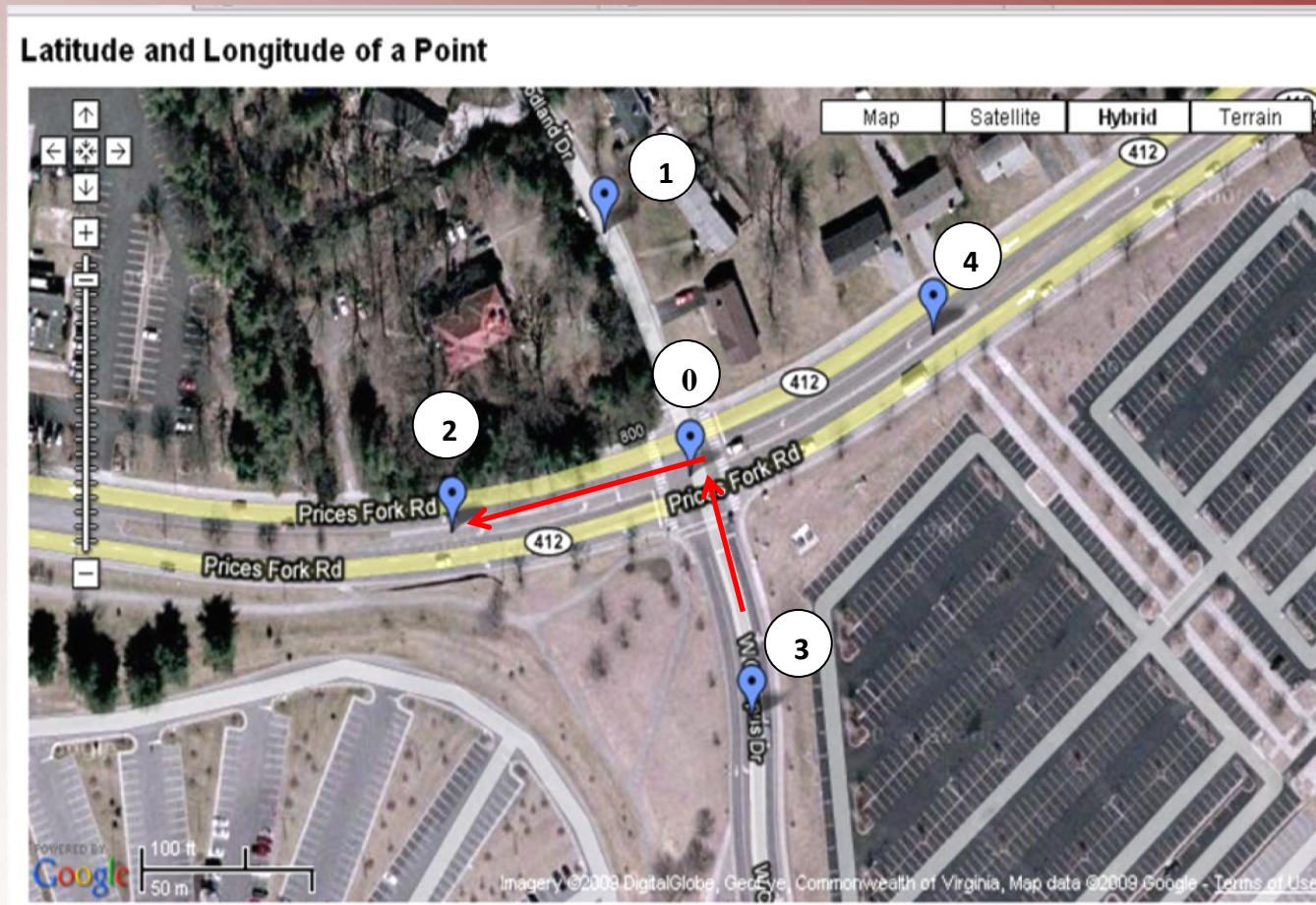


# Data Mining: Intersection Database

- DBs were selected that could be used to compare older drivers to middle and teen-age drivers: Older Driver & 40-Teen – same geographic area



# Data Mining: Path Definition



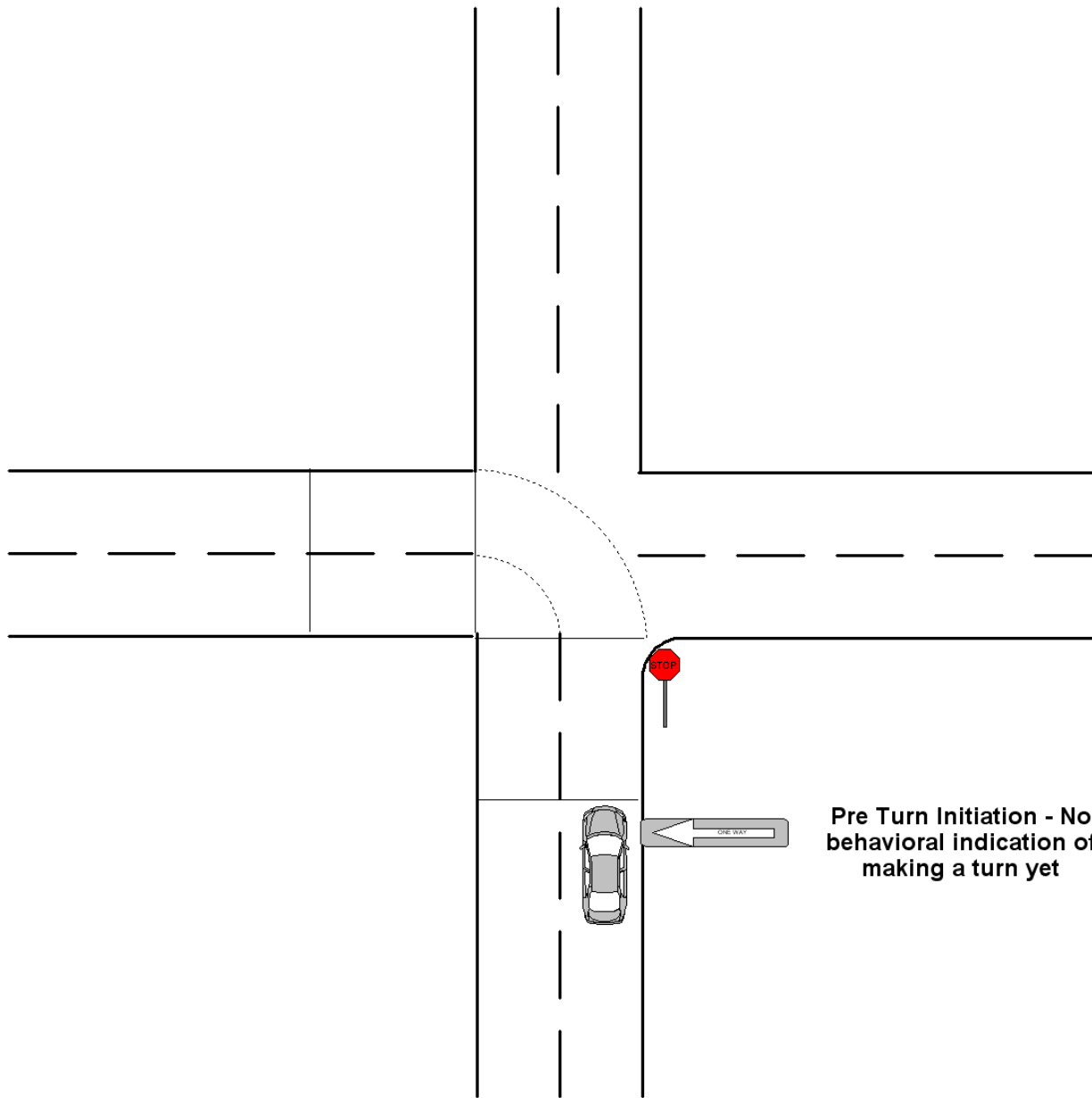
# Intersection Turns Examined

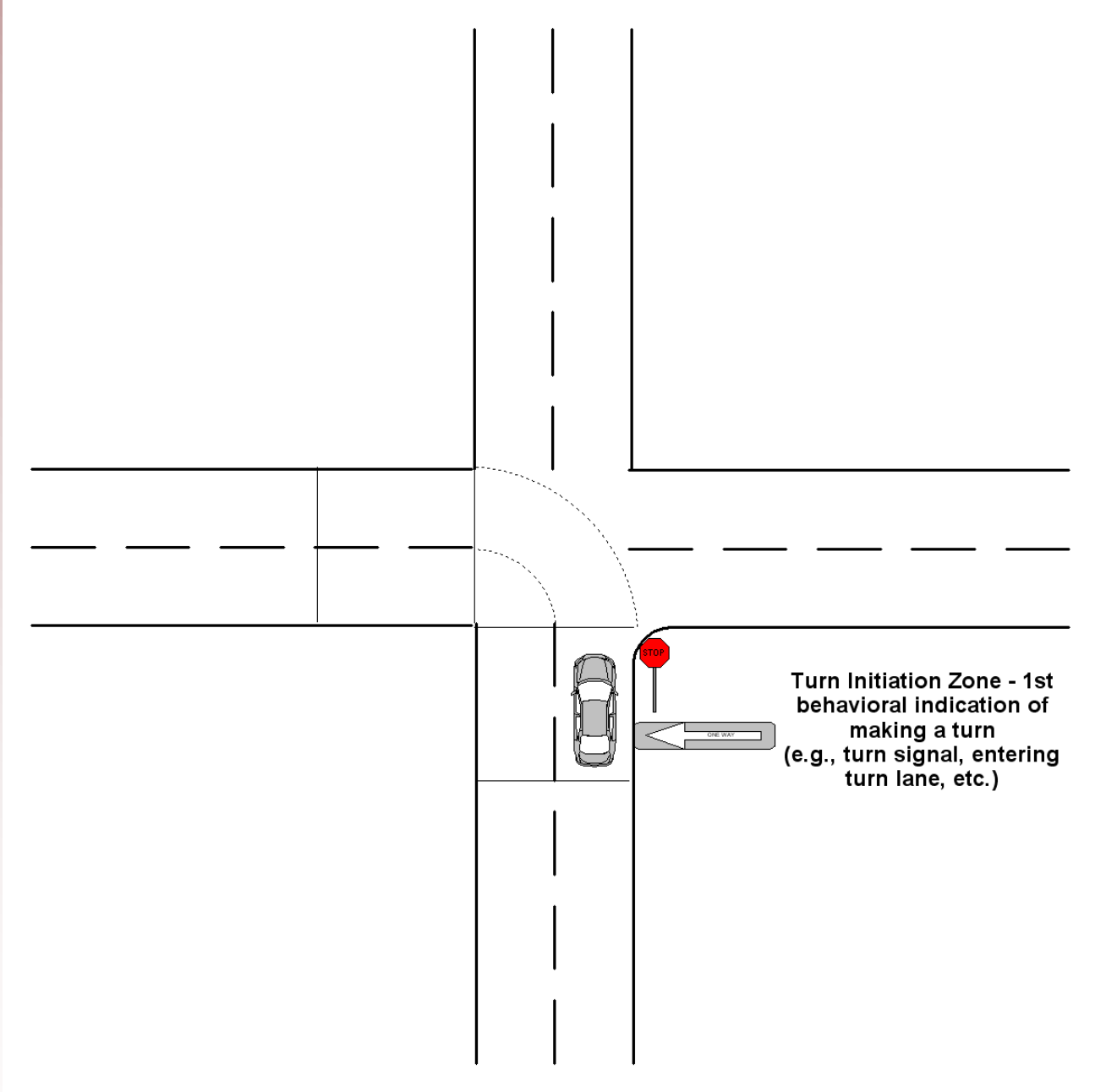
- Signalized, Protected Intersection
- Unsignalized, Unprotected Intersection  
with stop sign
- Unsignalized, Unprotected Intersection  
with no signage and no through traffic

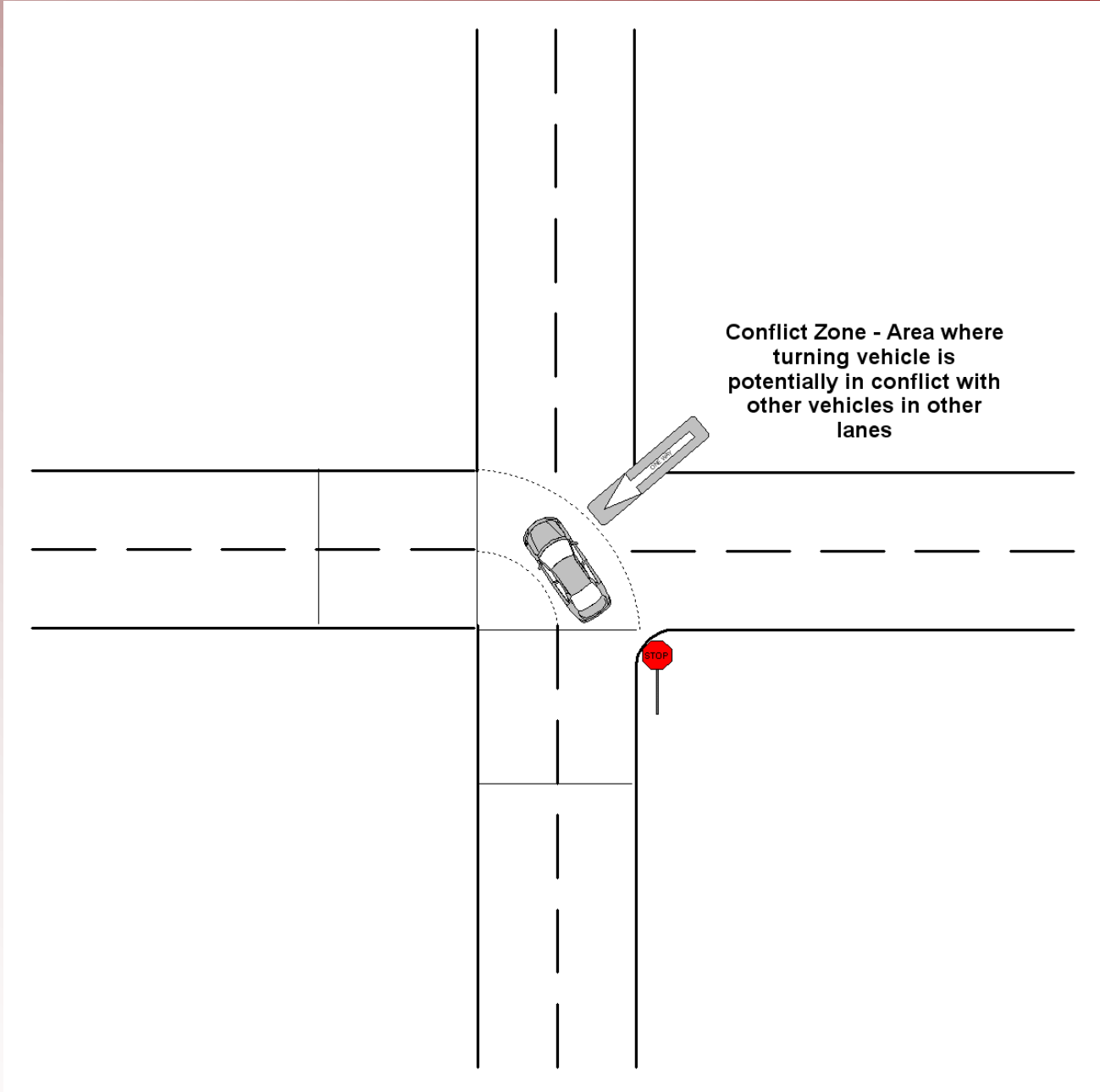


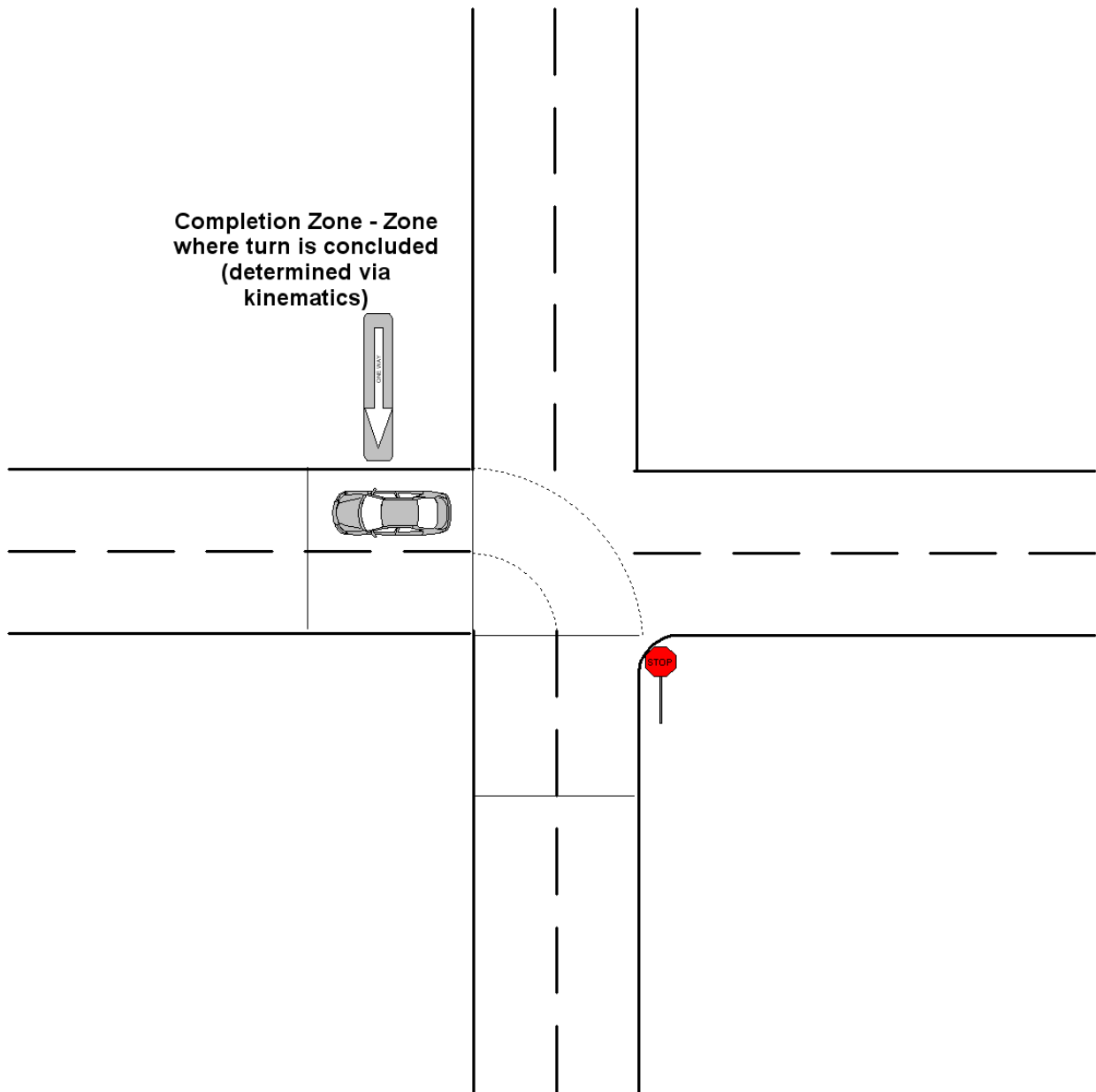
# Intersection Zones

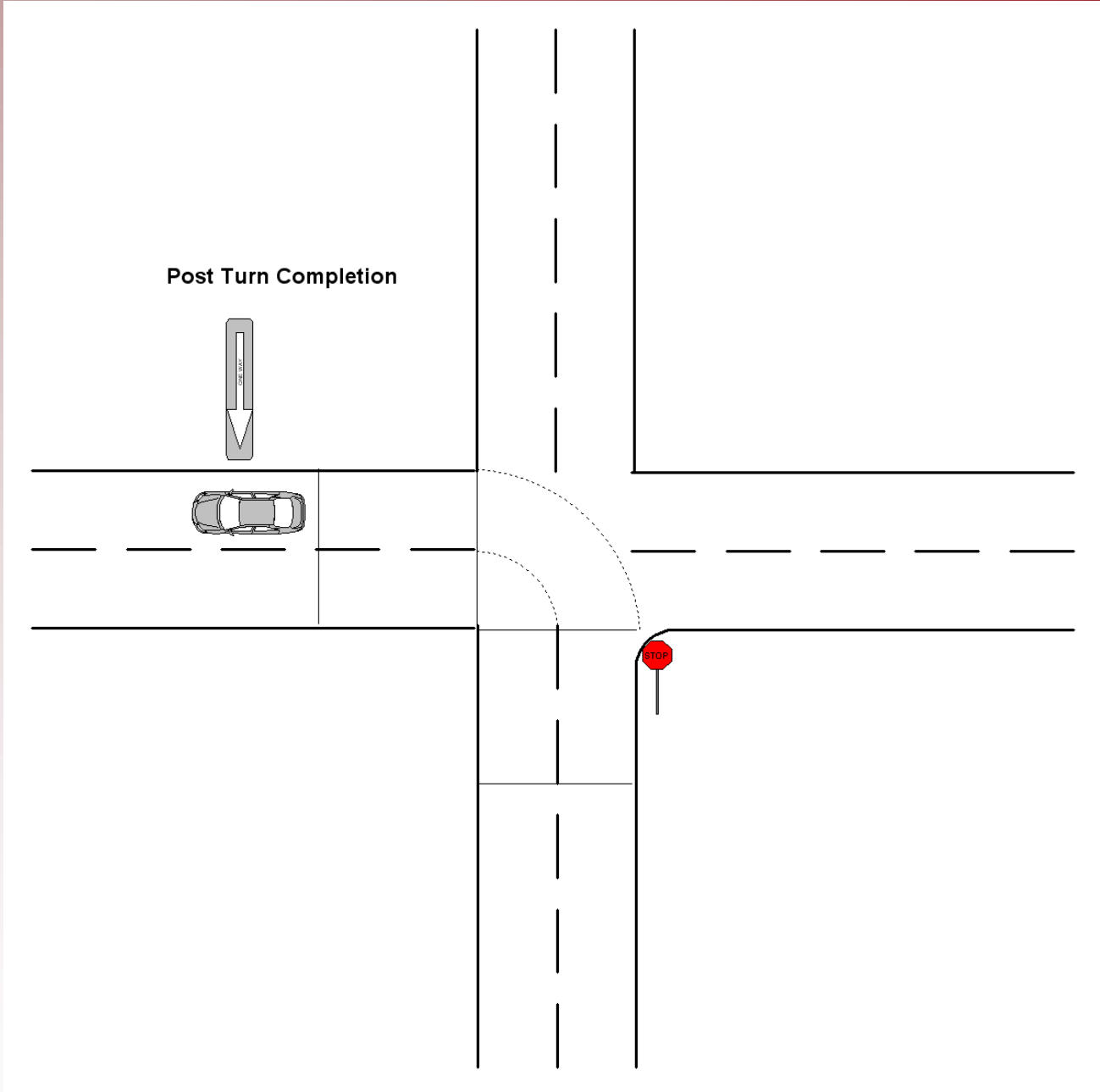
- Turn Initiation
- Conflict
- Turn Completion







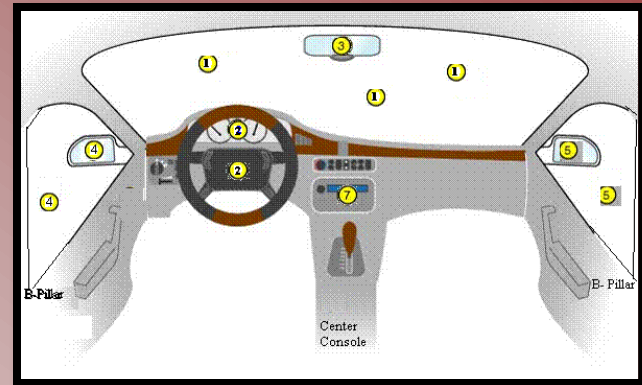




# Metrics

- Extent of active glancing  
(manual glance reduction)

- Proportion of glances by areas
- Total Time Looking by areas
- Glance Entropy
- Spatial Concentration of Gaze



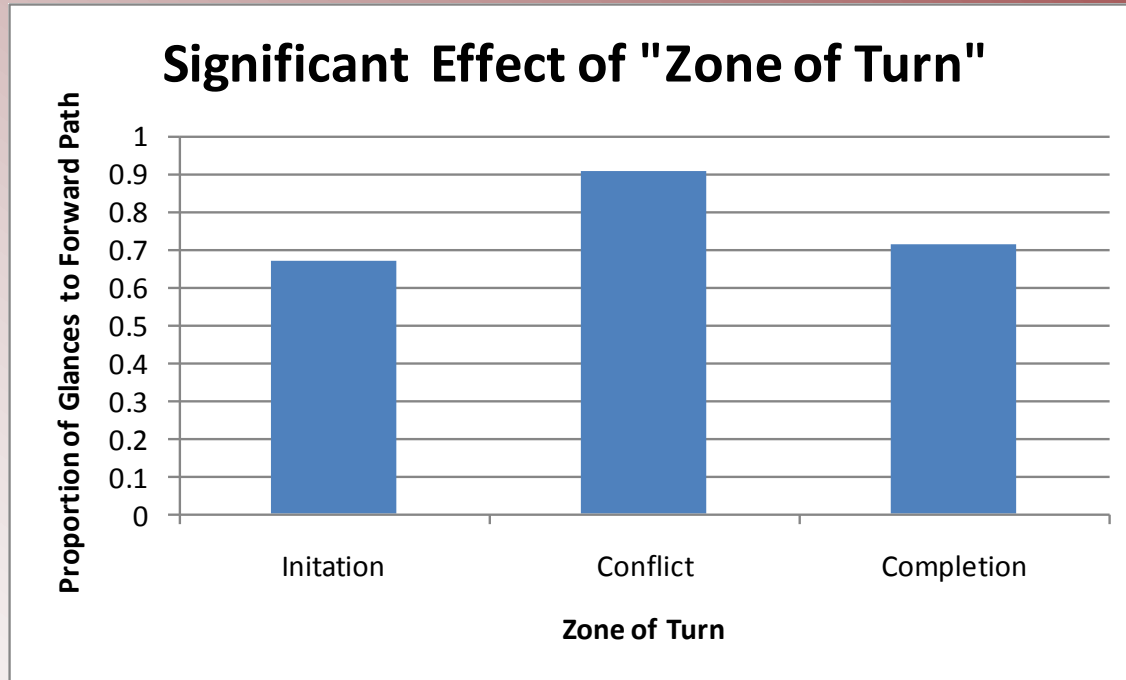
# Early Findings

“Proportion of glances” to *forward* and *rightward* areas were significantly affected by:

- Turn Type
- Zone of Turn
- Interaction of Turn x Zone
- Interactions with Age (no main effect of Age)
  - Age x Turn Type (Proportion Forward,  $p < .05$ )



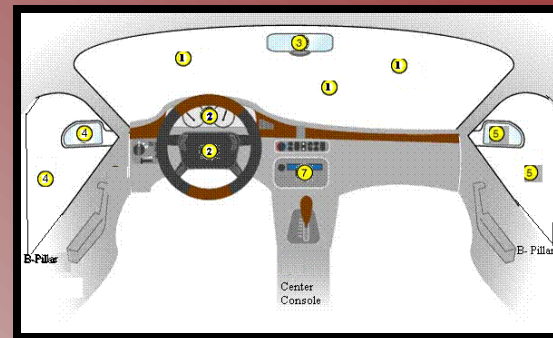
# Early Findings – Zone of Turn

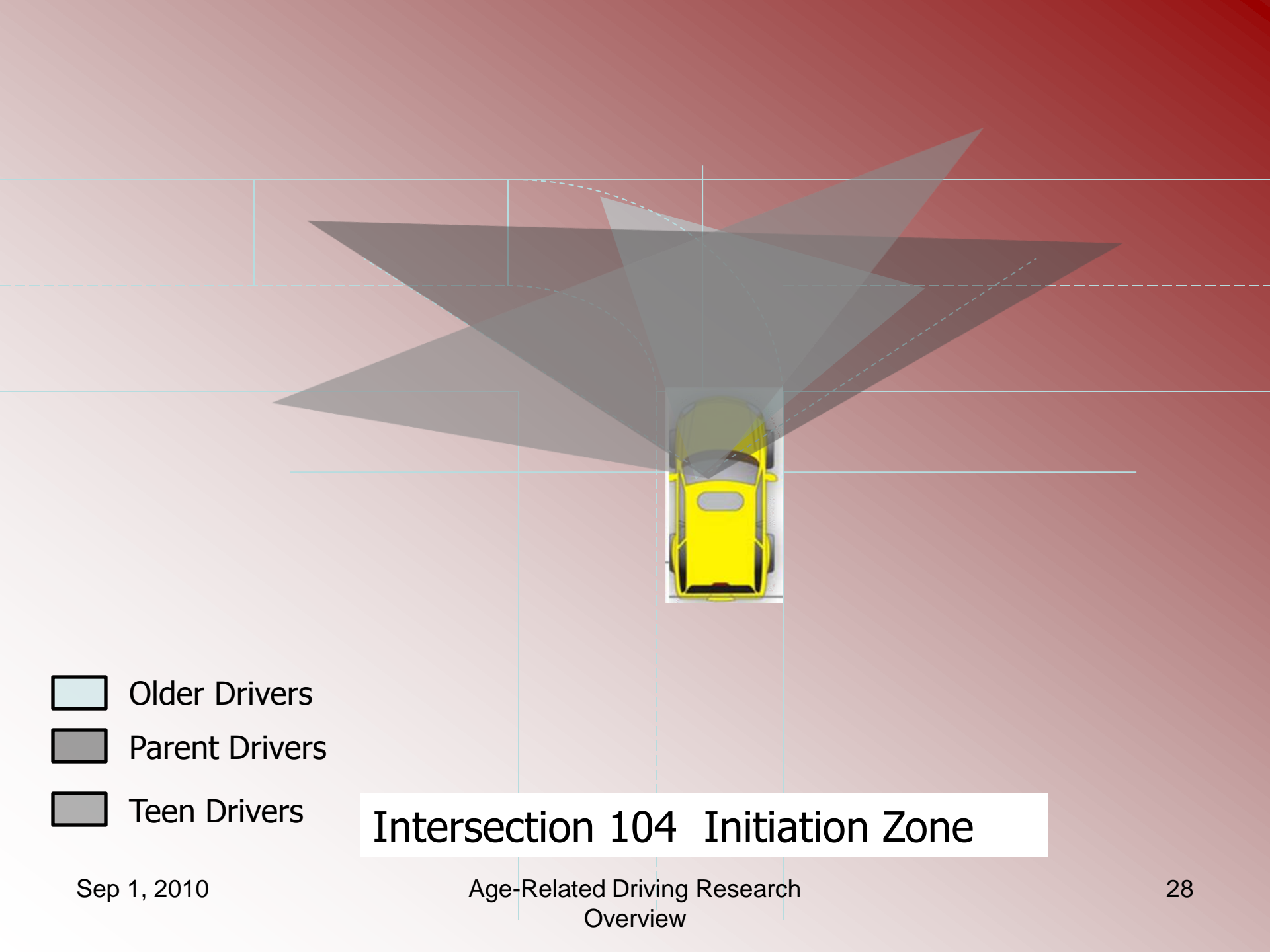


Higher proportion of Forward glances in "conflict" zone.

# Metrics

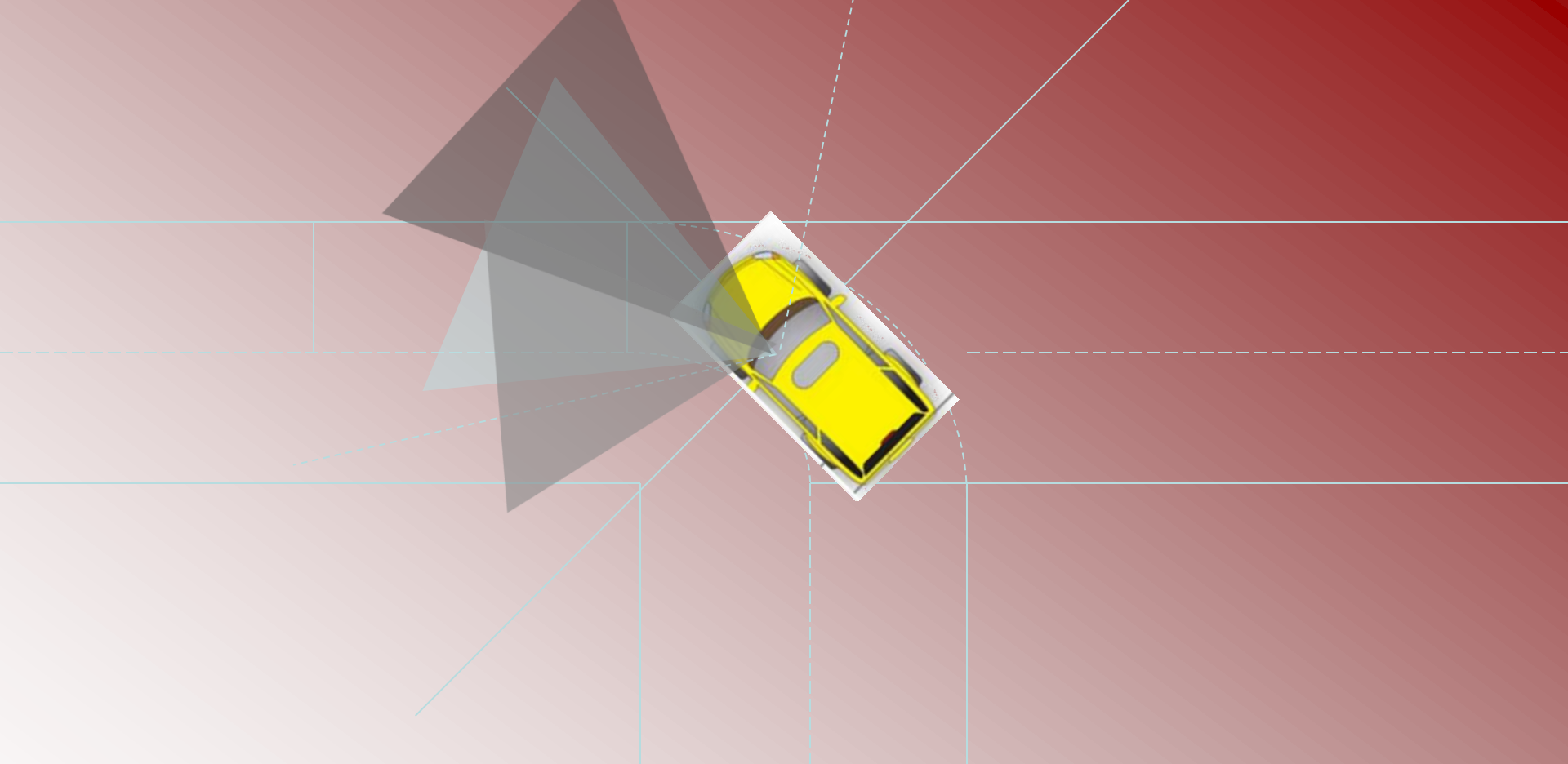
- Extent of active glancing (manual glance reduction)
  - Proportion of glances by areas
  - Total Time Looking by areas
  - Glance Entropy
  - Spatial Concentration of Gaze
- Extent of head rotation (Mask)
  - Proportion of Head Positions toward areas
  - Total Time with Head Positioned toward areas
  - Head Position Entropy
  - Spatial Concentration of Head Positions





- Older Drivers
- Parent Drivers
- Teen Drivers

Intersection 104 Initiation Zone

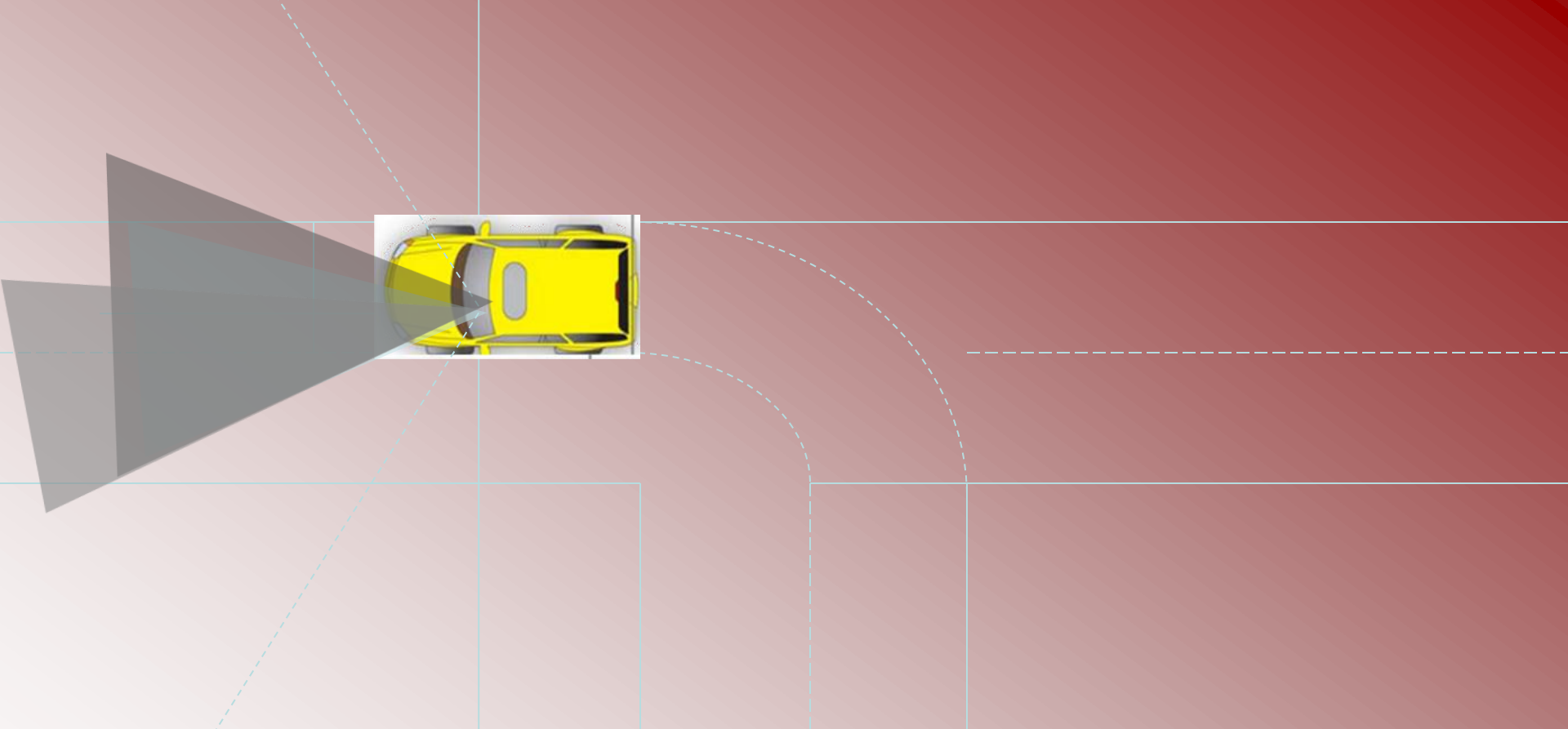


- Older Drivers
- Parent Drivers
- Teen Drivers

# Intersection 104 Conflict Zone

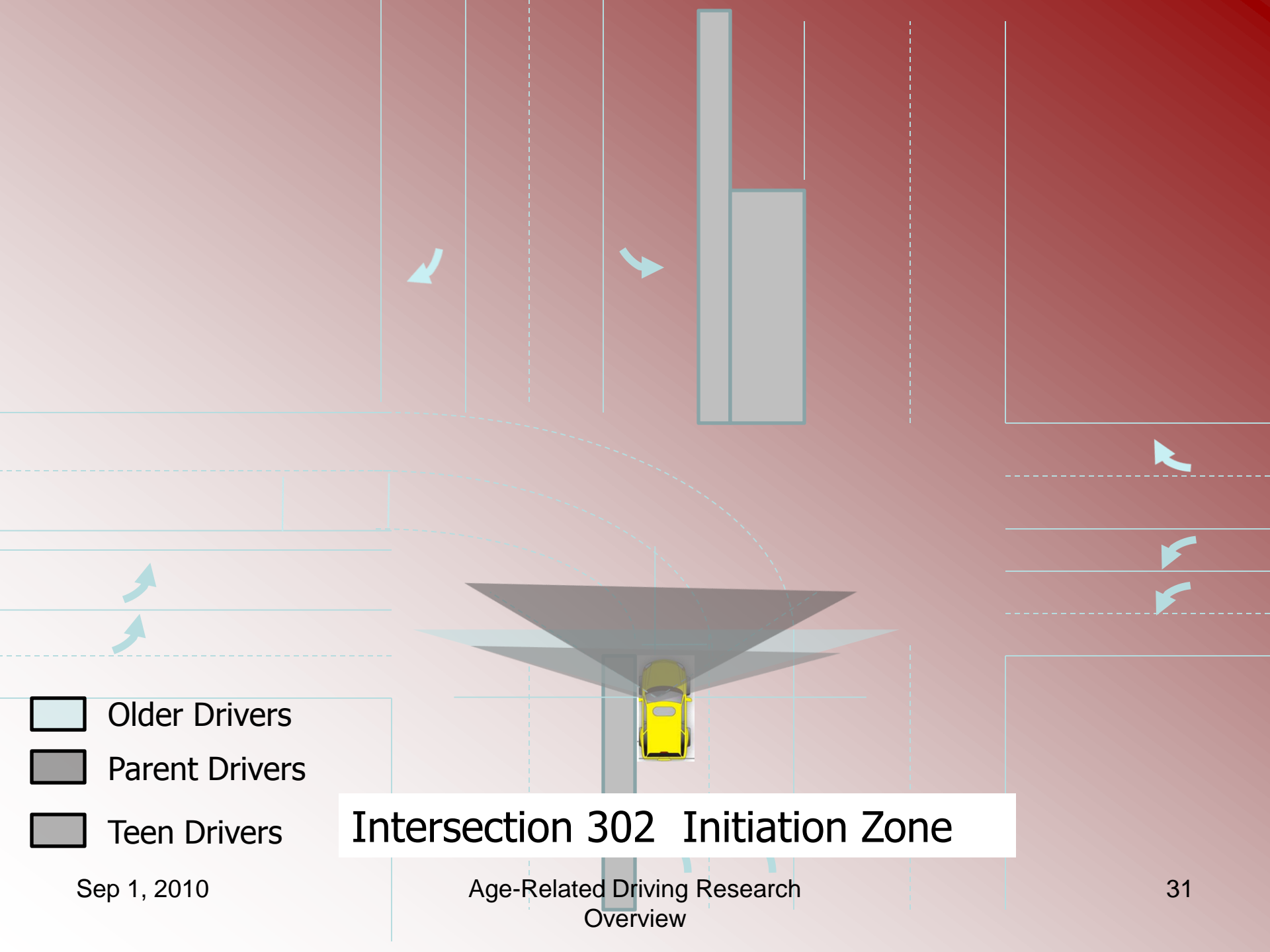
Sep 1, 2010

Age-Related Driving Research  
Overview



- Older Drivers
- Parent Drivers
- Teen Drivers

# Intersection 104 Completion Zone

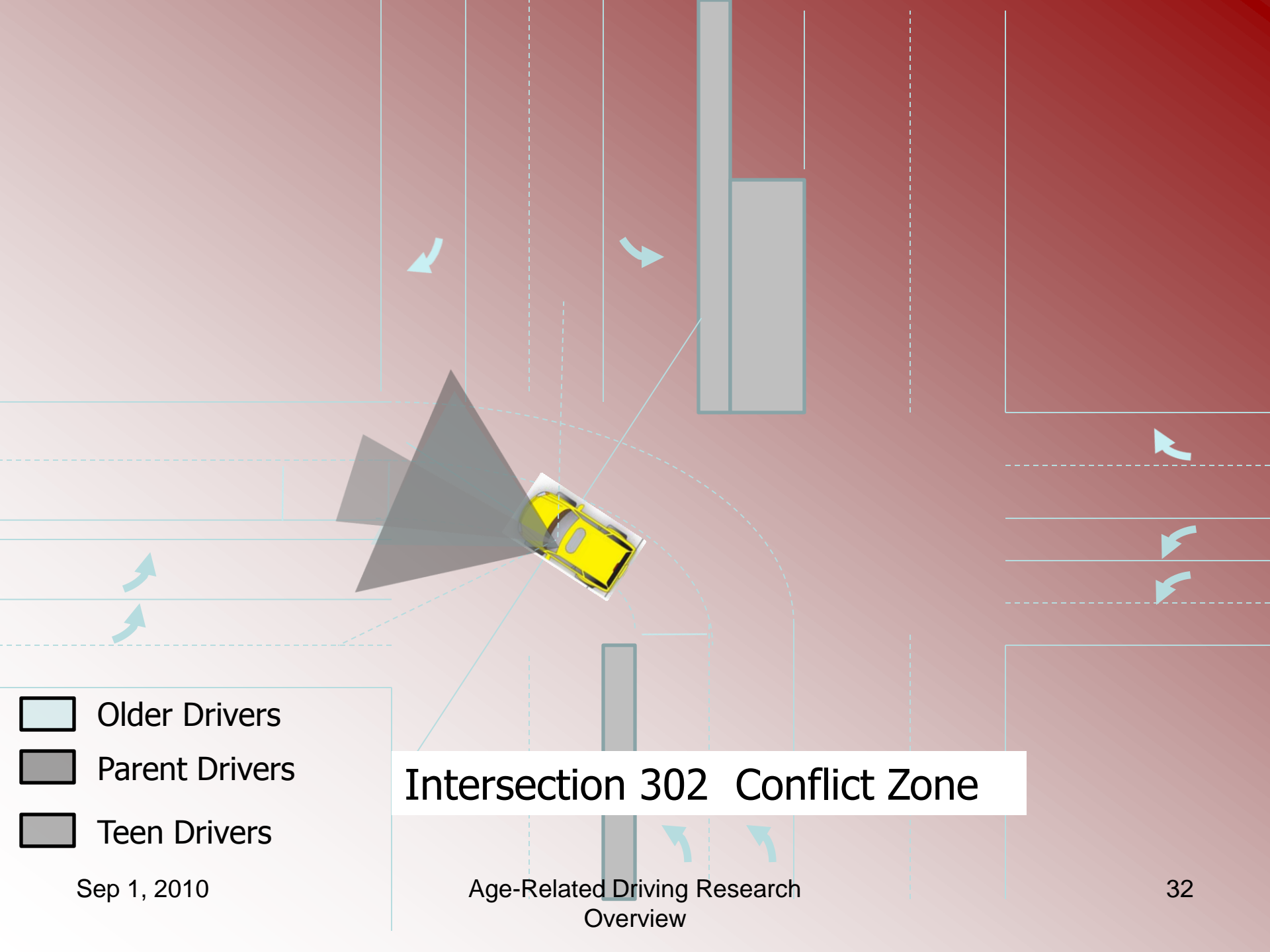


- Older Drivers
- Parent Drivers
- Teen Drivers

**Intersection 302 Initiation Zone**

Sep 1, 2010

Age-Related Driving Research  
Overview

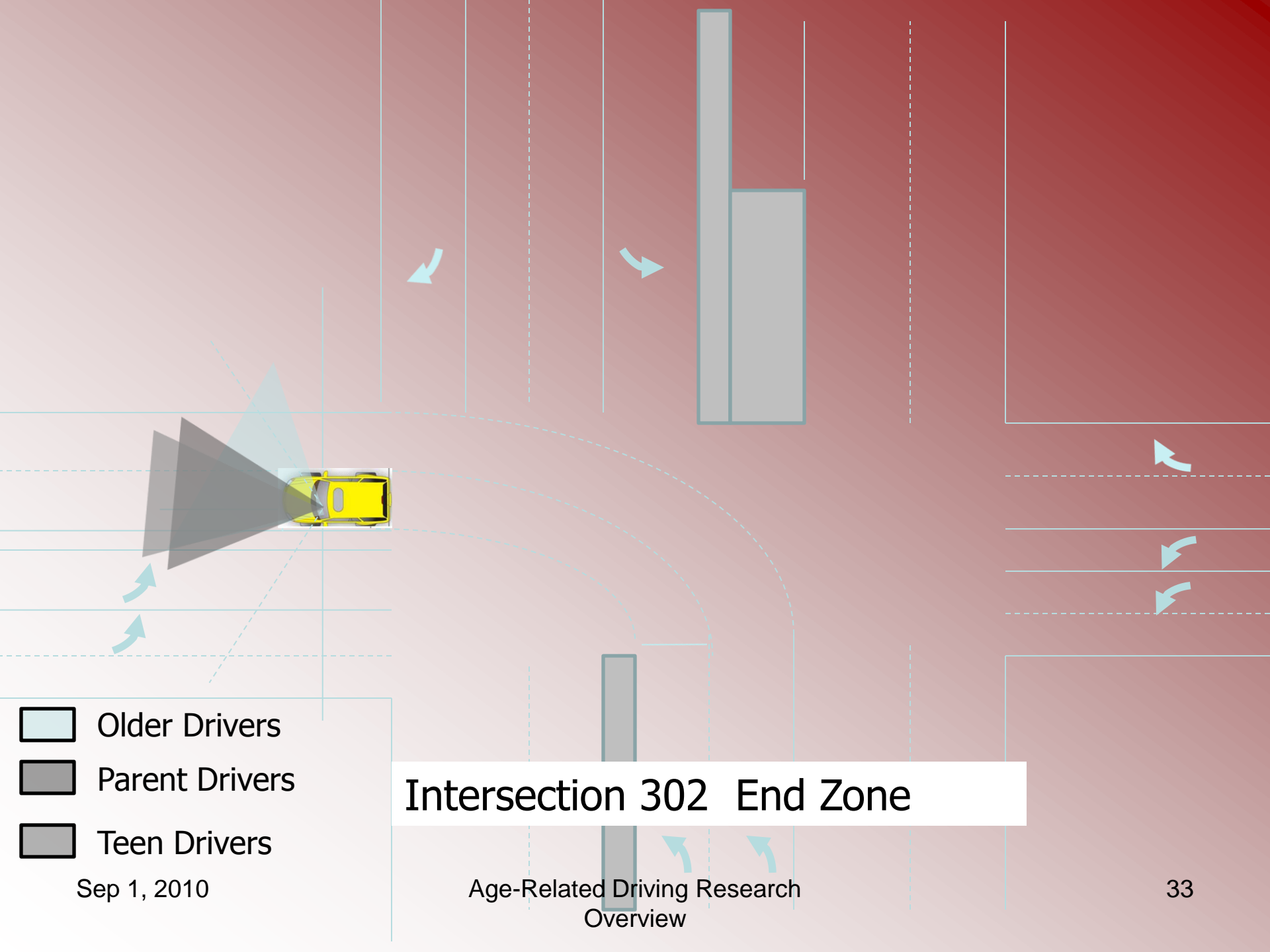


- Older Drivers
- Parent Drivers
- Teen Drivers

**Intersection 302 Conflict Zone**

Sep 1, 2010

Age-Related Driving Research  
Overview



- Older Drivers
- Parent Drivers
- Teen Drivers

Sep 1, 2010

**Intersection 302 End Zone**

Age-Related Driving Research  
Overview



# Conclusions

- **This study extended VTTI's capabilities** for studying driver behavior at intersections:
  - Algorithms for finding and matching turn types at intersections in naturalistic databases
  - New tools & metrics for analyzing head positions
- **This study also** revealed that while different ages do scan differently at intersections:
  - *scan patterns are uniquely affected by turn-specific variables*
  - *scan patterns are affected by the changing information demands as a driver progresses through the zones of a turn*

# Next Steps

- To initiate analysis on driving performance measures:
  - Approach speeds to intersections
  - Turn initiation speeds
  - Times through intersection
- Examine other factors that may affect visual scanning (e.g, traffic, roadway)
- Integrate functional & health assessment data