Assessing Senior Driver Performance

Increasing Situational Awareness Through Post-Drive One-on-one Advisement

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Older Driver Crashes

(Ryan, Legge, & Rosman, 1998), p. 382

HUMAN PERFORMANCE LABORATORY

- Overall, drivers 18 years old and younger and 70 and older have higher accident rates

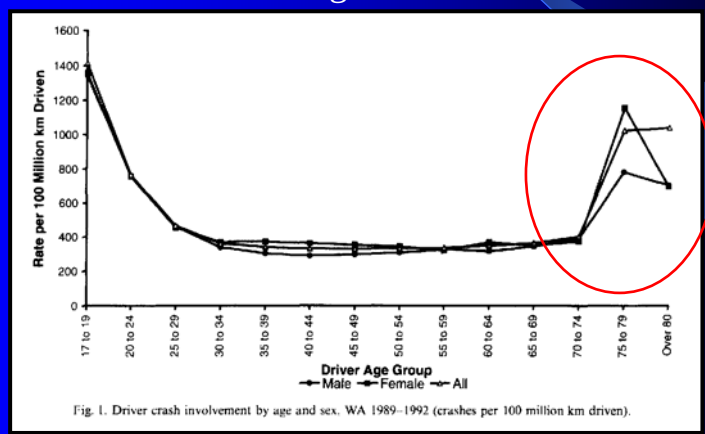
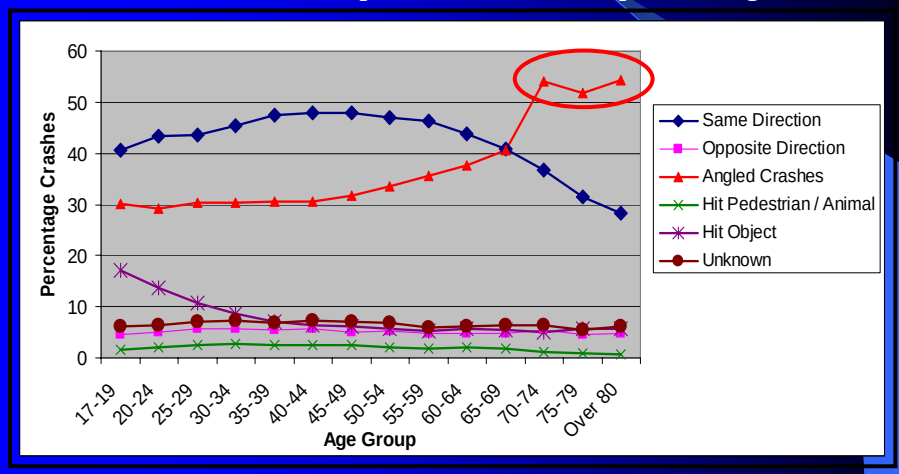


Fig. 1. Driver crash involvement by age and sex. WA 1989–1992 (crashes per 100 million km driven).

Older Drivers and Crash Type

(Ryan, Legge, & Rosman, 1998), p. 382

Older drivers are over-represented in side-impact or angled crashes.



Other Types of Older Driver Crashes

- Angled impact crashes, especially in intersections.
- Lane changes
- Other crashes which require simultaneous central and peripheral processing

Causes of Crashes

- Arthritis and other musculoskeletal disorders
- Slowed response times
- Decreases in the ability to multitask central and peripheral stimuli

Goals of Research

- Determine whether older drivers are overinvolved in the same crashes on the driving simulator as they are in the real world
- Develop a feedback and advisement program that is individually tailored to the mistakes that an older driver makes in the simulated world
- Determine whether feedback and advisement program alters drivers' attitudes about their safe driving practices.

Older Drivers & Situation Awareness

- Level 1 Situation Awareness (perception)
  - Ability to perceive elements in the environment
  - Older Driver Impact: *Visual, physical, cognitive disabilities can negatively impact Level 1 SA by impeding detection, making it difficult to achieve accurate Level 2 SA.*
- Level 2 Situation Awareness (comprehension)
  - Integration of multiple pieces of information & determining relevance.
  - Older Driver Impact: *Cognitive slowing, decreased short term memory span, disinhibition, diminished UFOV can make it difficult to achieve Level 3 SA.*
- Level 3 Situation Awareness (projection)
  - Ability to forecast future situational events & dynamics

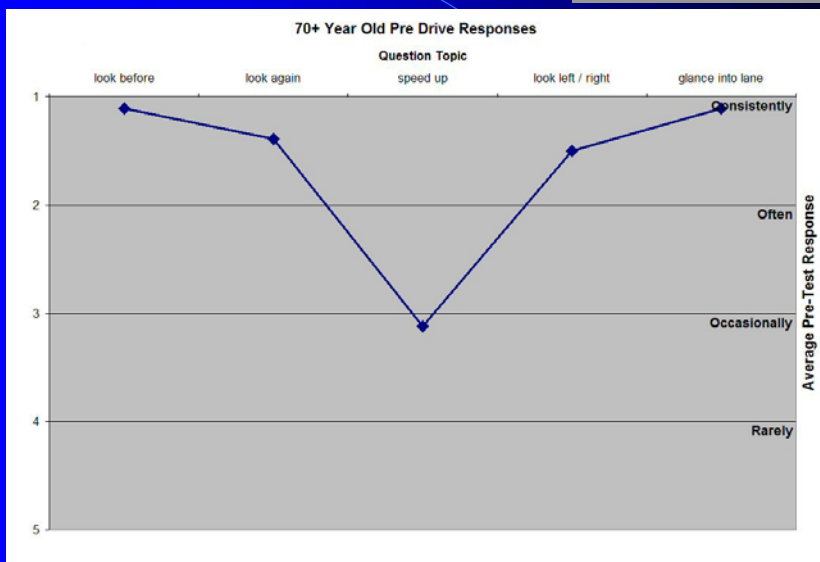
Experimental Design

- Participants *(as of December 2004)*
  - 18 Older, Experienced Drivers (70+ years old)
  - 18 Younger, Experienced Drivers (25-55 years old)
- Pre-drive questionnaire
- Simulator scenarios
- Feedback and advisement session
- Post-drive questionnaire

Pre-Drive Questionnaire

- 1) When stopped at an intersection, I look left or right before proceeding into the intersection to make sure that there are no oncoming cars;
- 2) After stopping at an intersection, I look a second time to the left or right during the turn to make sure that there are no oncoming cars;
- 3) When turning, I increase my speed if I think there is very little time to make the turn safely
- 4) When approaching a marked crosswalk, I look far to the left and right to see whether there are any approaching pedestrians or bicyclists
- 5) When changing lanes on a freeway, I glance into the lane into which I am changing to make sure that there is no other traffic in that lane.

Pre-Drive Questionnaire Results



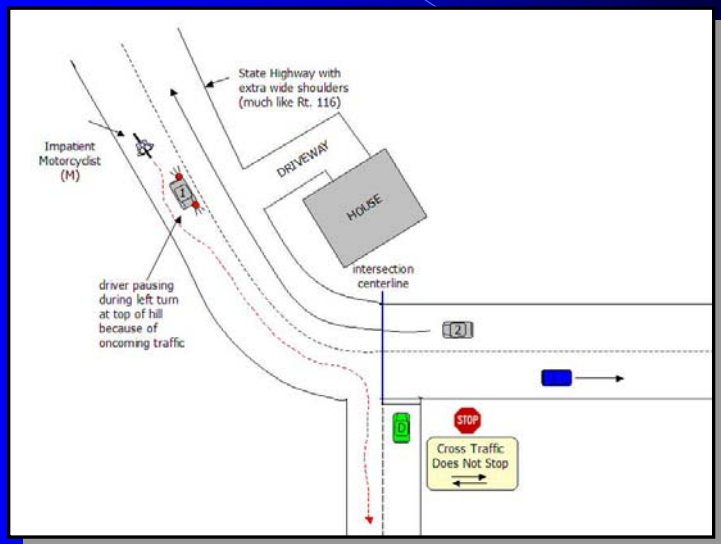
Scenarios

- Right turn scenarios
- Left turn scenarios
- Peripheral detection scenarios
- Lane change scenarios

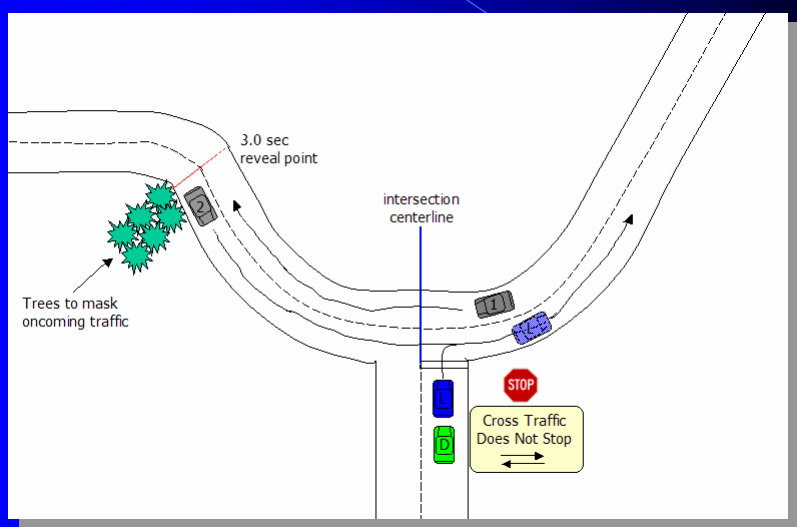
The HPL Driving Simulator

- 1995 Saturn
- SGI Infinite Reality System
- 3 Screens
- Software
  - Designers Workbench
  - Real Drive Scenario Builder
  - EasyScene
- **Integrated Eye Tracking System**
- Full sound
- Some tactile feedback
- Ability to simulate seasons, times of day, weather, road conditions, shading, etc.

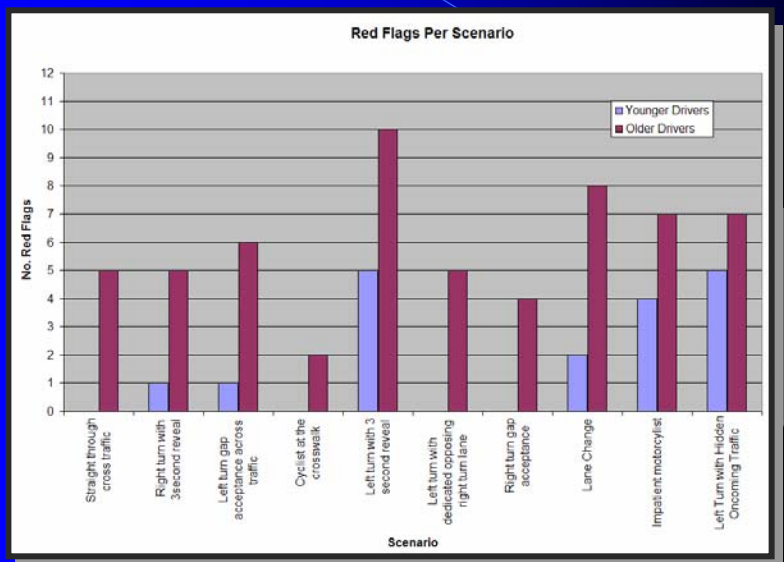
Scenario Example – Impatient Motorcyclist



Y Intersection Scenario



Red Flags (errors) per Scenario



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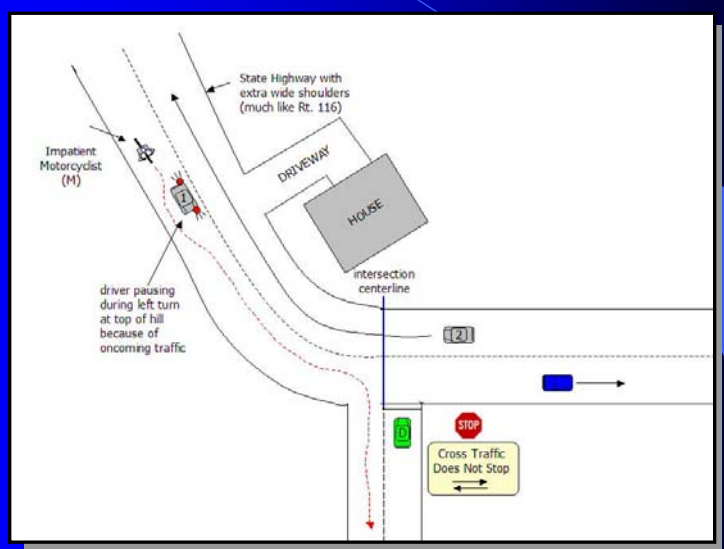


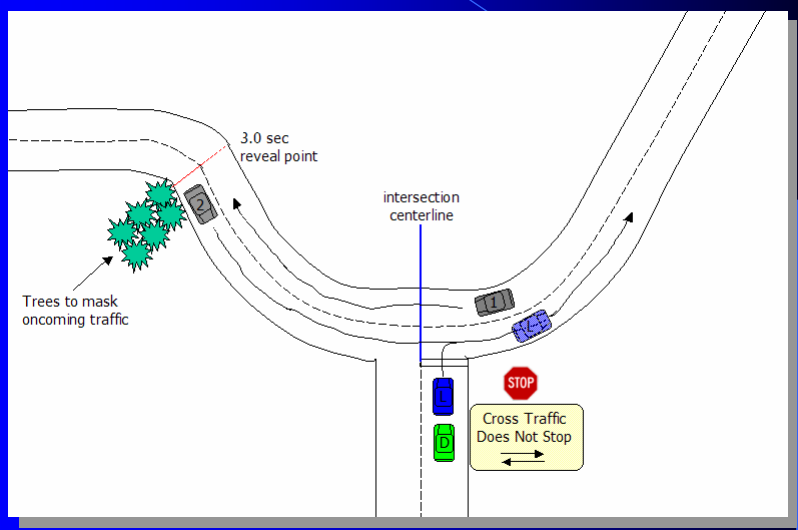
Frequency Distribution of Red Flags

Reason for Red Flag	Number of Red Flags
Driver failed to look before or during a turn	32
Driver turned too slowly	10
Driver merged too close to an adjacent vehicle	5
Driver failed to glance into adjacent lane before merging into it	3
Driver failed to fixate on the risk in the periphery field of vision	2

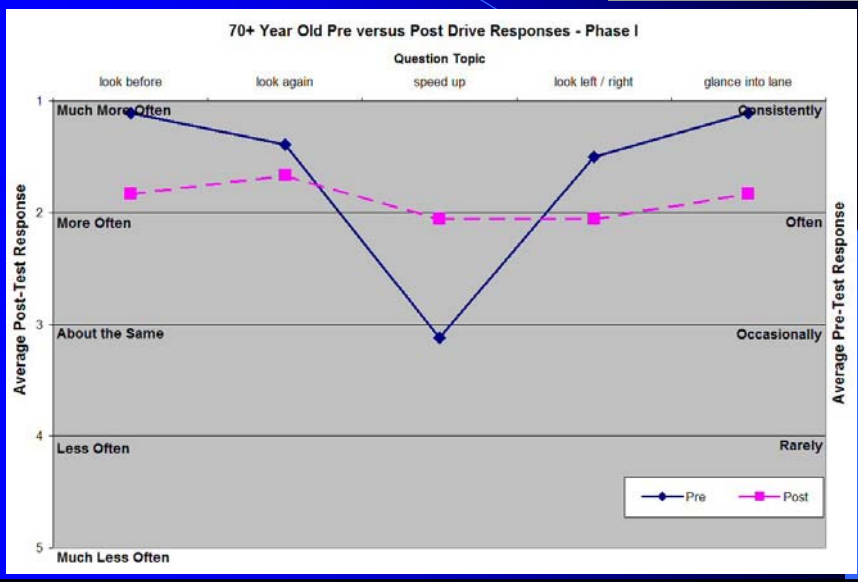
Feedback and Advisement

- Stage 1: Replay of scenario
- Stage 2:
  - Safe drive
  - Unsafe drive

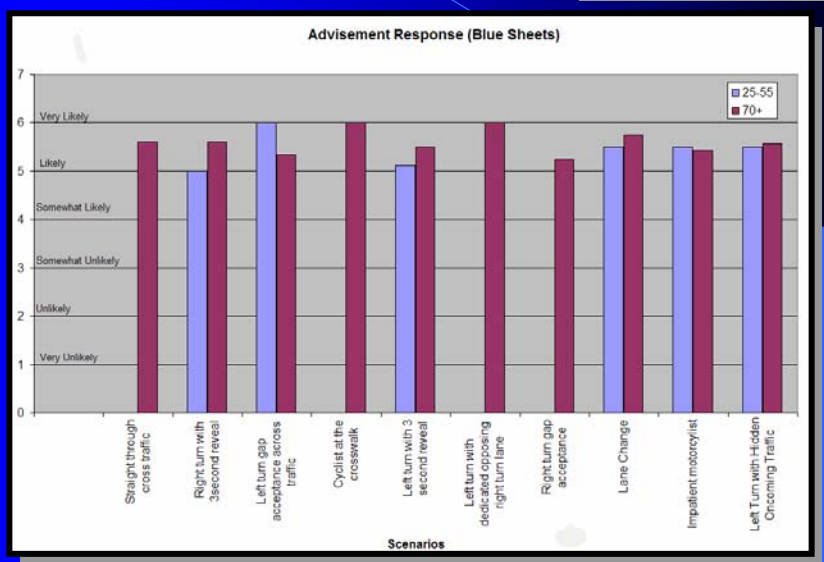
Feedback: Y Intersection Scenario



Post-drive questionnaire



In scenarios with red flags, how likely is the driver to modify behavior?



Procedure – Participant Follow-up

- Ten (10) senior drivers were invited back after 6 months
- Two Cohorts
  - 5 with most red flags (high RF) – 5 or more
  - 5 with the least red flags (low RF) – 2 or fewer
- Scenario scenery was changed to disguise the 10 driving scenarios
- All 10 drivers drove all three blocks of scenarios again, determining red flags the same way as in their 1st drive

Follow-up Results

- Both low RF and high RF drivers saw an overall decrease in the number of red flags compared to 1st drive
- High RF drivers – reduction was 20.8%
- Low RF drivers – reduction was 12.5%
- Several of the drivers informally reported that they had made a deliberate effort to incorporate the strategies they learned in the 1st session into their day-to-day driving habits

Conclusions

- Simulation based training can be an effective means of driver instruction
- Replaying drivers' actual drives provides high degree of "face validity" and positively influences driver's self image of their own ability
- Drivers demonstrated genuine interest in their results & were surprised when results did not correlate with their self image
- Post-drive feedback can be an effective means of increasing a driver's situational awareness

Acknowledgements

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Acknowledgements

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Questions & Comments?

Other Aspects on Older Drivers Found in the Literature

- Older drivers, on average, take approximately 2 seconds longer to complete a left-hand turn than younger drivers. (Keskinen, et al., 1998)
- 44% of older drivers, compared to 26% of younger drivers, were unaware of the other vehicle before it hit them. (Hakamies-Blomqvist, 1994)
- When risky elements are directly in front of the driver or easily discriminated from their background, older drivers do as well as younger drivers in recognizing and responding to the risk. (DeRamus, 2005)
- In general, the majority of older drivers self-limit their driving behavior if they perceive that there are areas in which they have difficulty when driving. (Ball, 1998; Ryan, 1999).