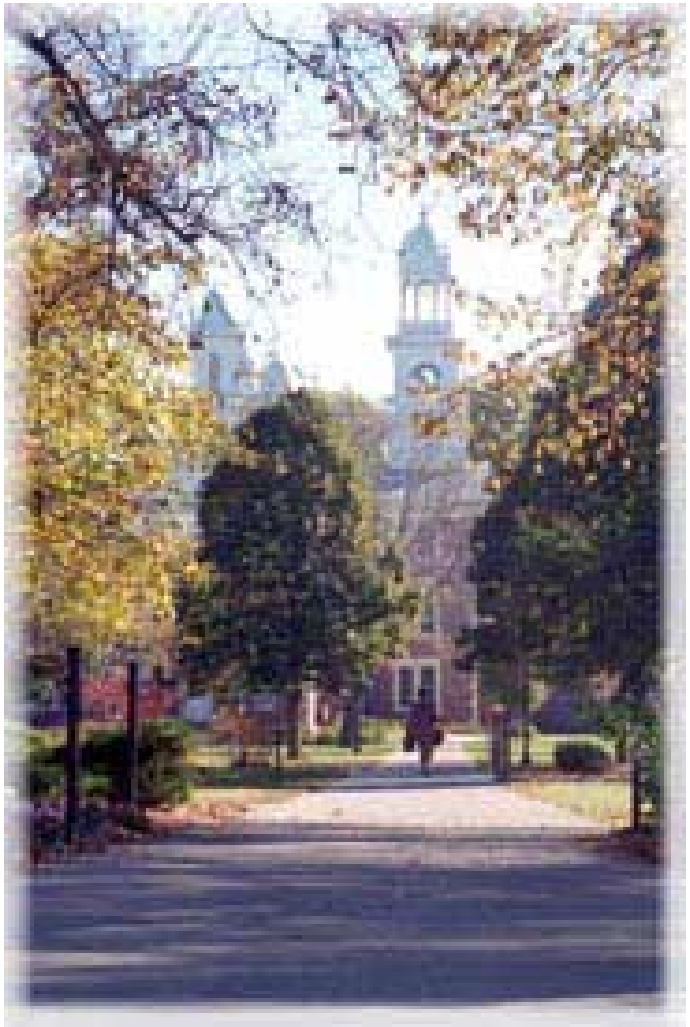

# Age-Differences in the Visual Information Processing Demands of Vehicle Instrument Panel Interfaces

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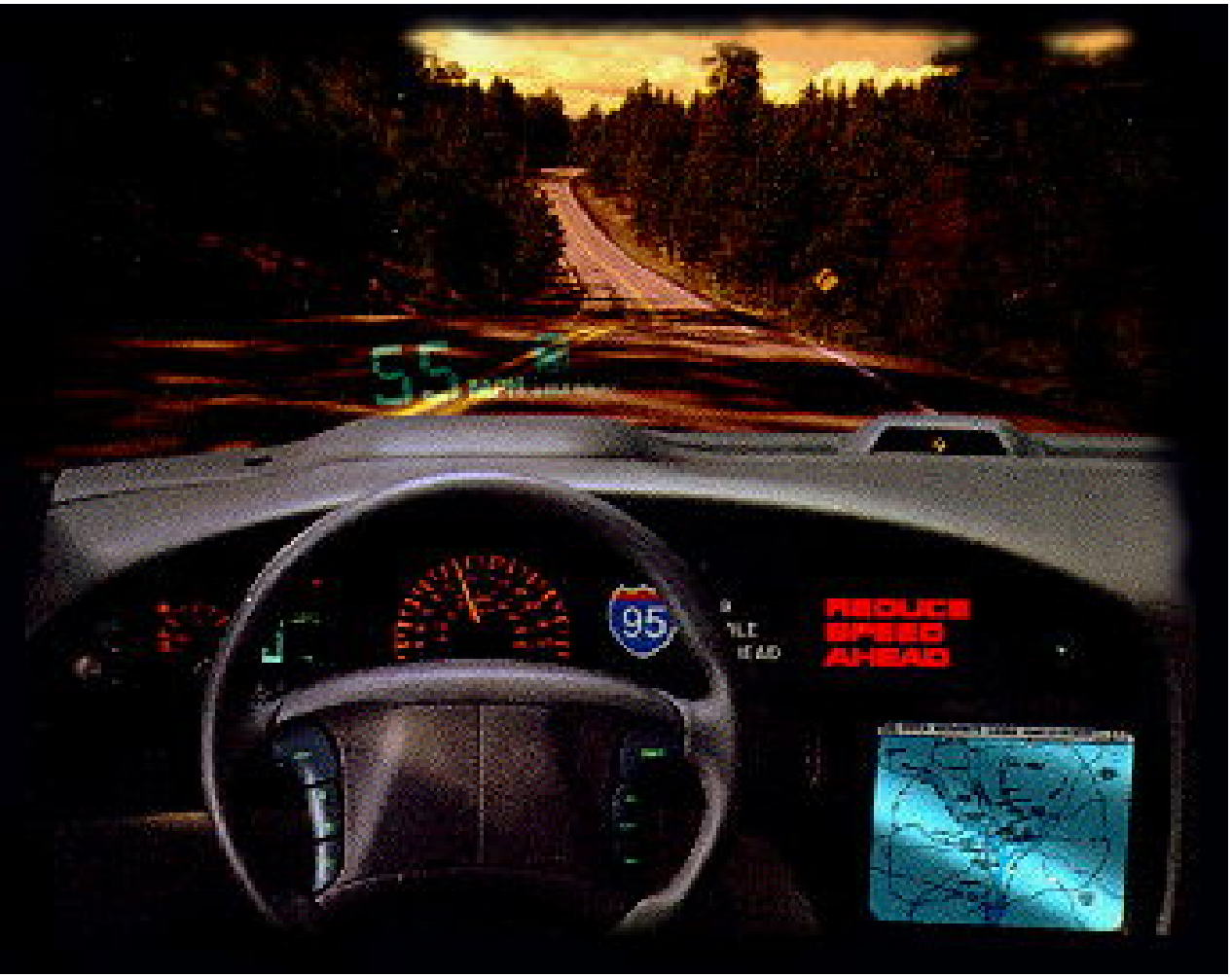
**University of South Dakota**

# Preliminary Results of a Driving Simulation Study

# The Nature of the Driving Environment is Changing

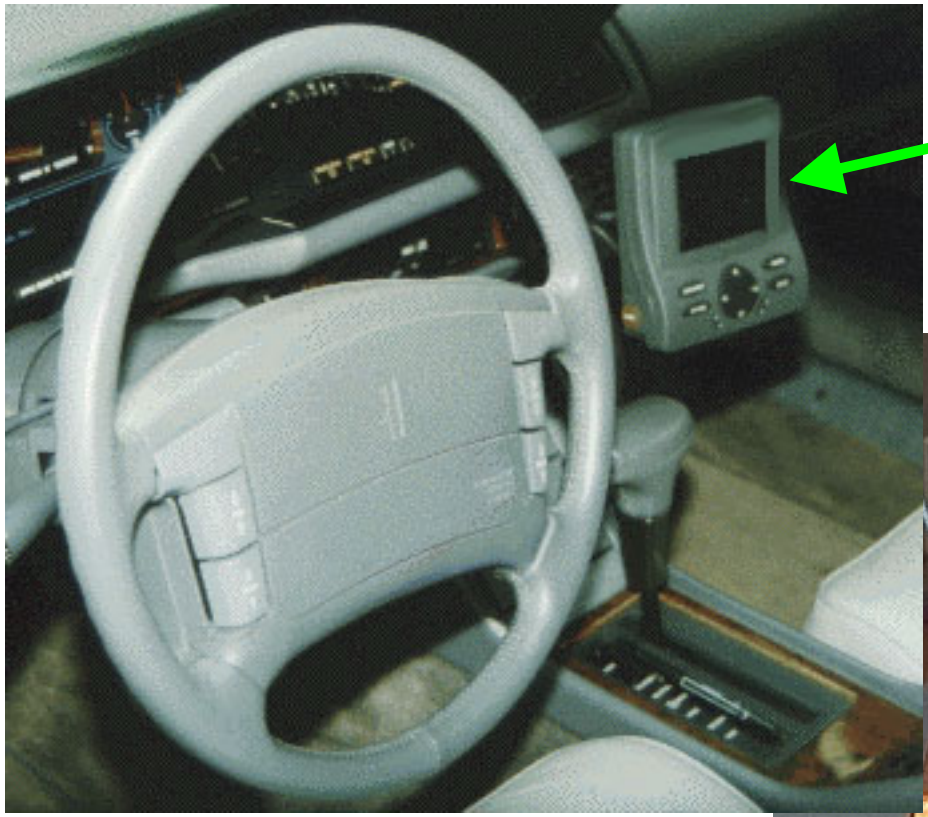
- More sophisticated instrument panels will impose increased demands upon driver attentional resources

- Aging of the driving population (with age-related reductions in attention)

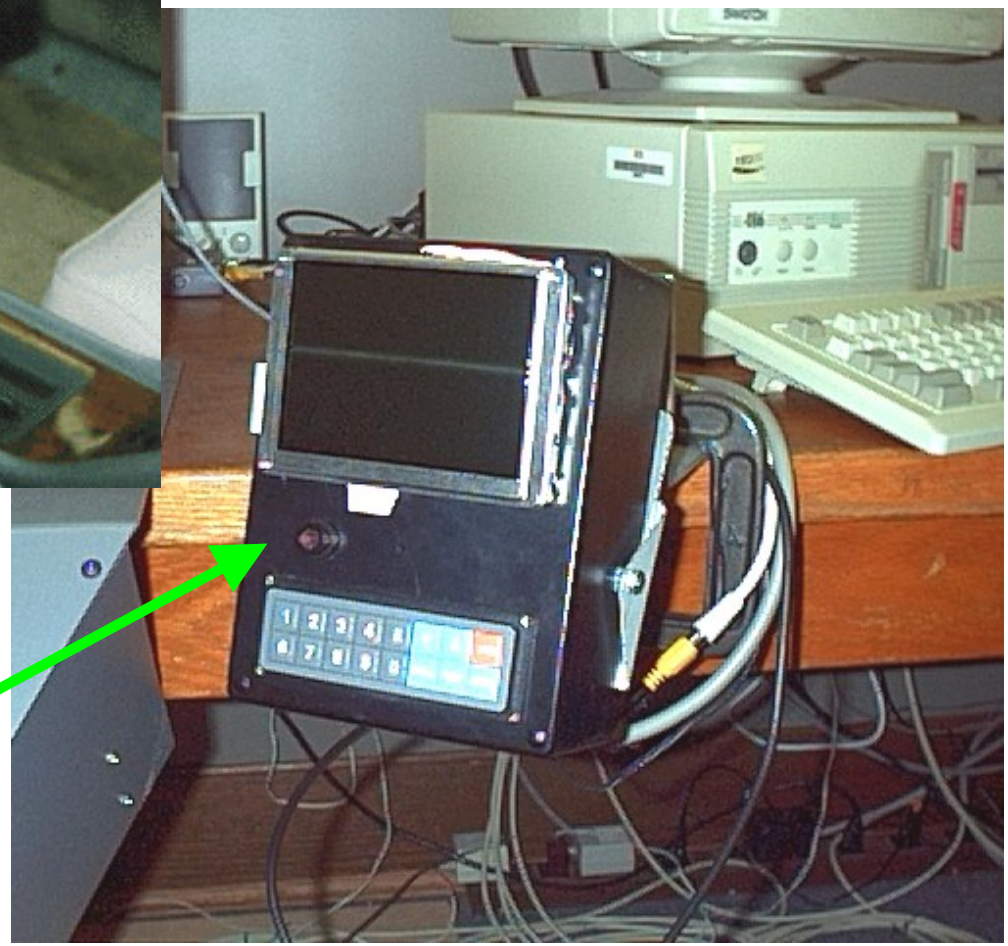



- Head-up displays
- In-vehicle traffic signs/warnings
- ATIS interactive displays
- Internet console ??

# Advanced Instrument Panel Development



Wireless Applications Protocol Browser



Experimental Text Messaging Console

# Research Questions

- What are the visual demands imposed by in-vehicle text display consoles?

- How do these demands vary with aging?

# Experimental Design

- Age
  Young (20-25) vs. older (67-82) drivers
- Message Length
  Read in-vehicle text messages of variable length (6 levels: 1, 2, 3, 4, 6 & 8 lines)
- Roadway Condition
  4 levels of geometry: straight; work zone; sharp curve; and, passing zone/maneuver

# Visual Demand Proxy Measures

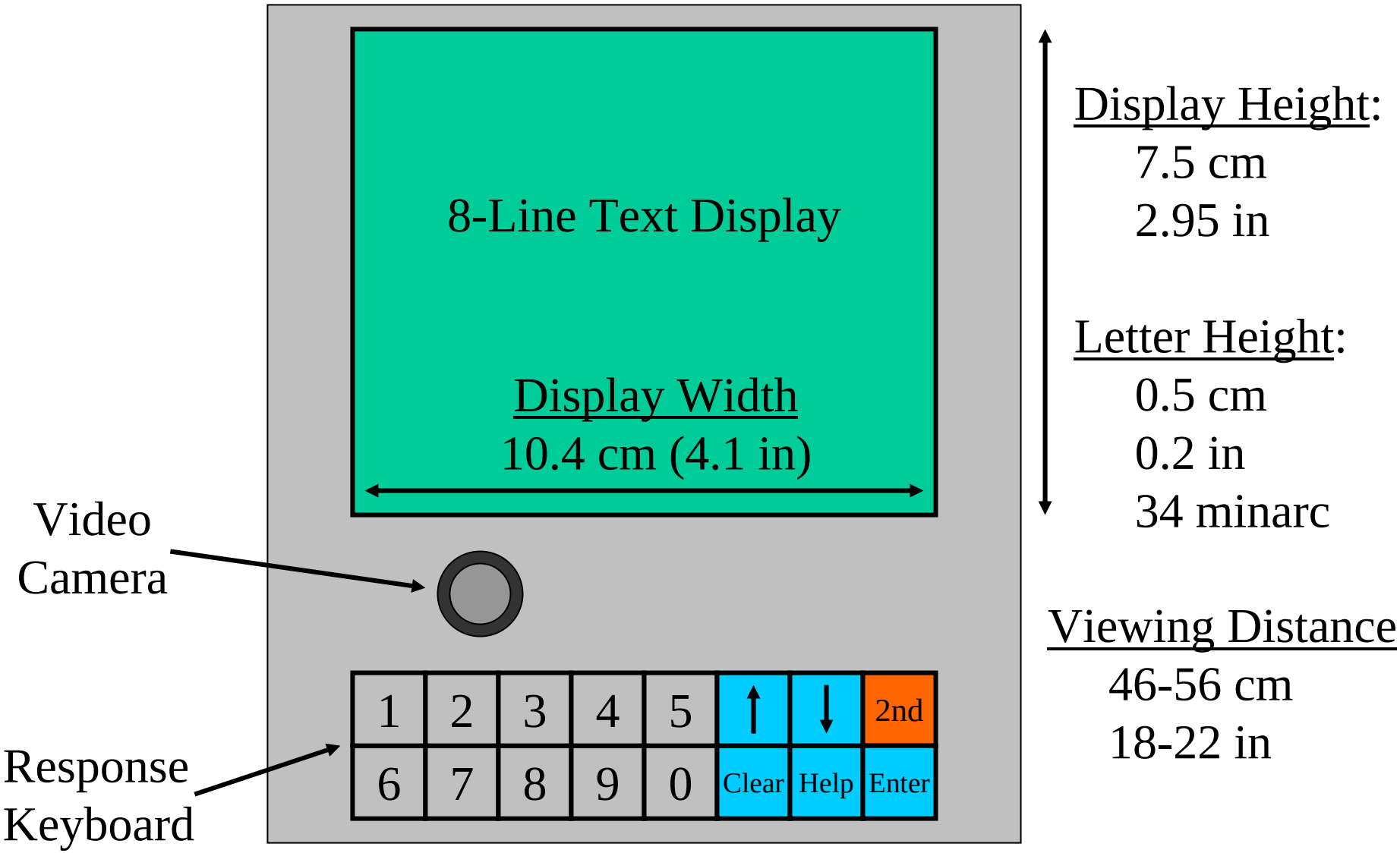
- Driving Performance Decrements
  - Crashes
  - Speed variability
  - Steering variability

- Eye movement patterns
  - Eyes-off-road time
  - Glance frequency/duration

# STISIM Driving Simulator (v. 8.0)

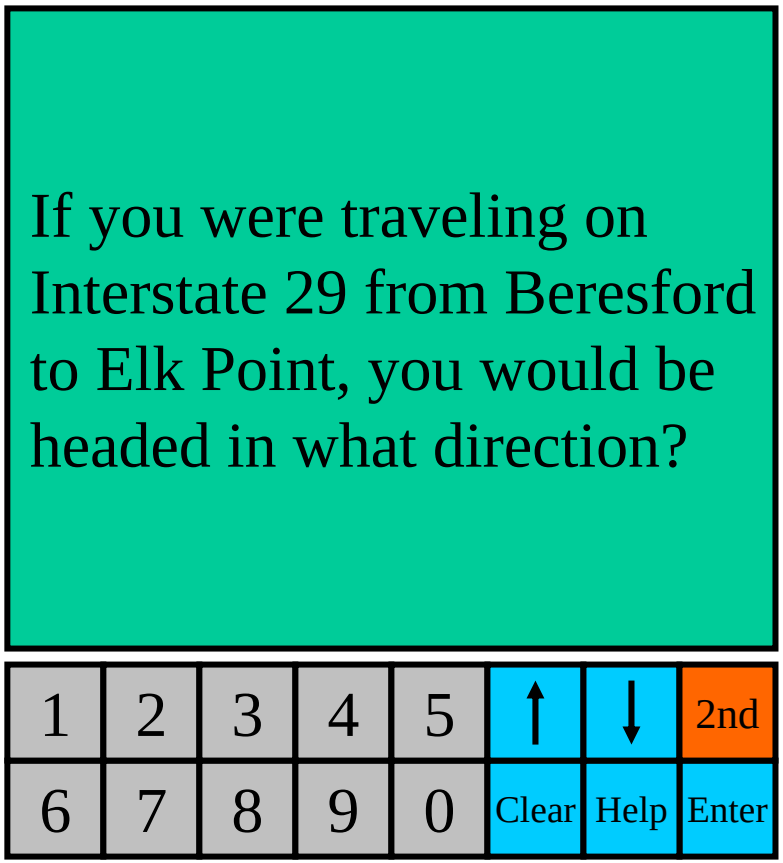

Special thanks to the 3M Company for the STISIM system.

# Text Message Console

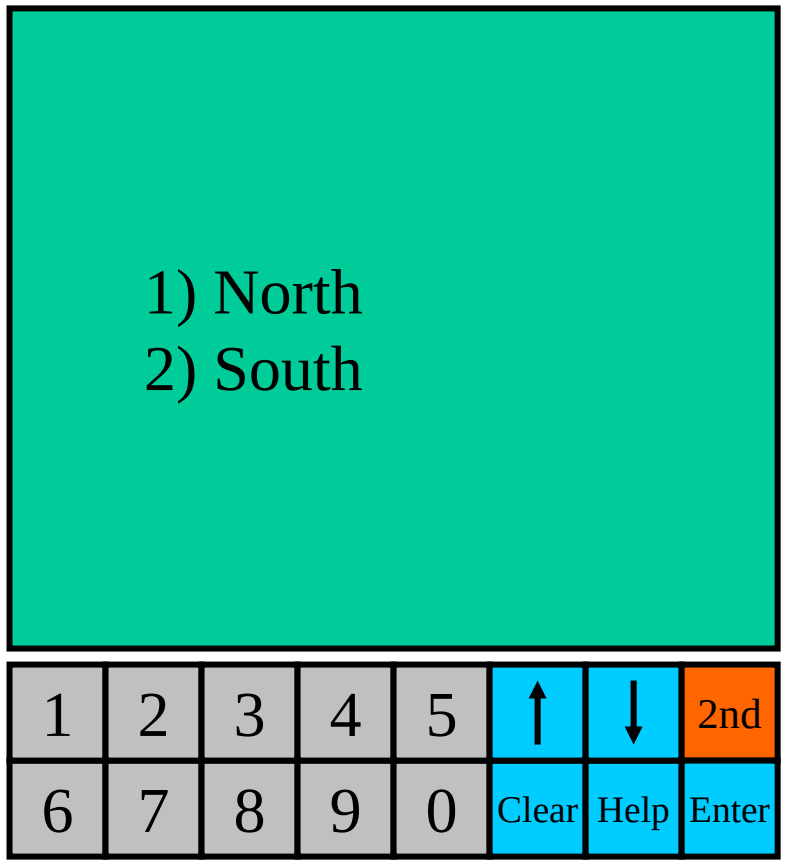


# Sample 4-Line Text Dialog

(24 point Times-Roman font)

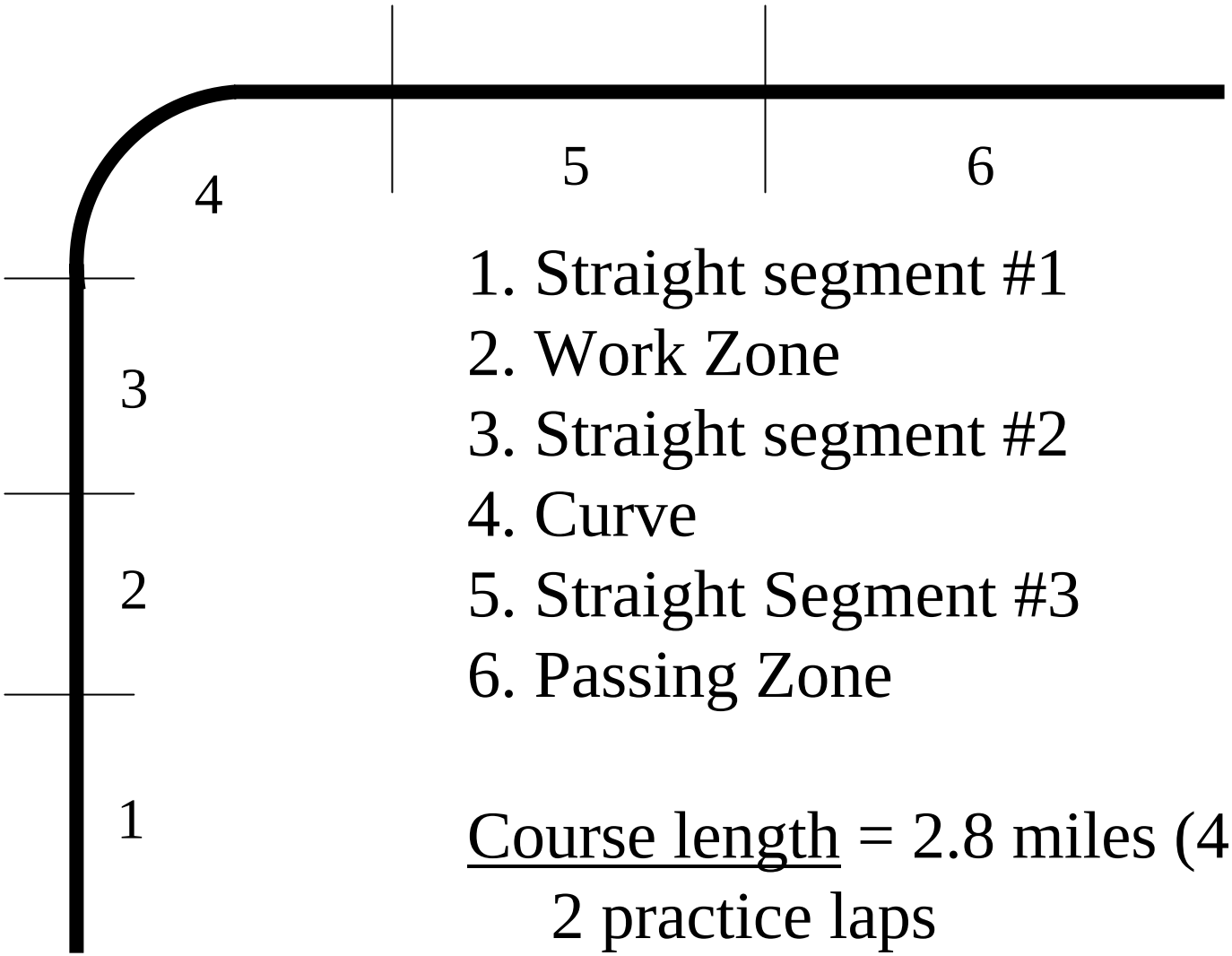



Message Screen




Response Screen

# Simulated Driving Course




1. Straight segment #1
2. Work Zone
3. Straight segment #2
4. Curve
5. Straight Segment #3
6. Passing Zone

Course length = 2.8 miles (4.5 km)

2 practice laps

8 experimental laps

# Impact of Reading Text upon Simulated Driving Performance

Dependent Measures

- Crashes
- Steering instability (lane position variability)

# Crashes - Young Drivers

24 opportunities to crash while reading a message
(4 highway complexity conditions x 6 message lengths)

Some crashes were observed!!!

2 percent crash rate across 384 experimental trials.
(less than 1 crash per participant)

# Crashes - Older Drivers

46.8 % crash rate while reading text messages

| Crash Rate (%) | Highway Condition |
|---|---|
| 25 | Straight Roadway |
| 42 | Sharp Curve |
| 46 | Passing Maneuver |
| 75 | Work Zone (narrow lane) |

# Steering Instability

- Lane position error increases with driver age
- Lane position error increases with message length
- Young Drivers
  1-2 lines = baseline; 3+ lines > baseline
- Older Drivers
  1 line = baseline; 2+ lines > baseline

# Video Clips

## Reading Text Messages on Straight Road Segments

Older Driver; Straight - Message Length = 1

Older Driver; Straight - Message Length = 2

Older Driver; Straight - Message Length = 3

Older Driver; Straight - Message Length = 4

# More Video Clips

Reading Text Messages

Complex Roadway Conditions

Older Driver; Passing Maneuver - Message Length = 6


Young Driver; Passing Maneuver; Message Length = 8


Young Driver; Sharp Curve; Message Length = 6

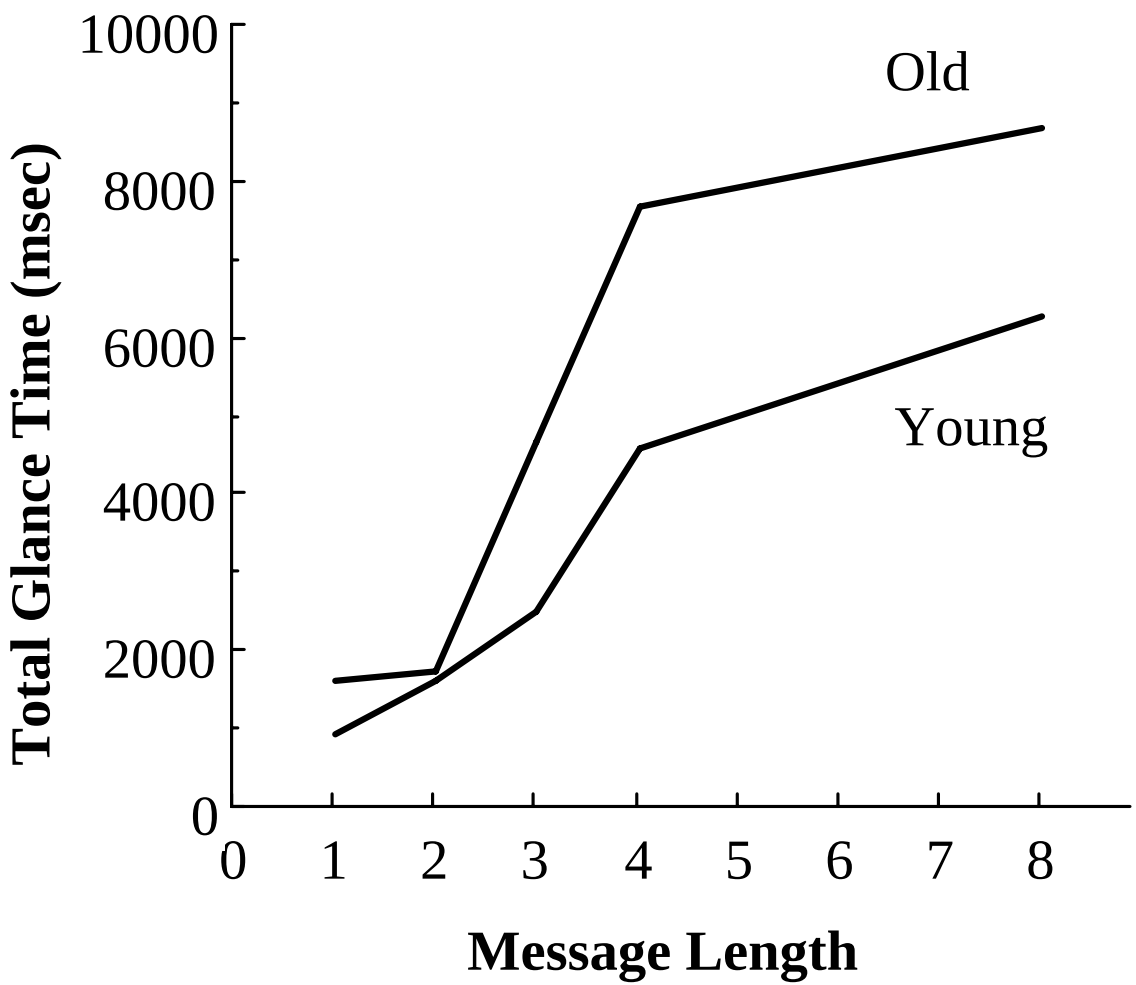

Young Driver; Work Zone; Message Length = 3

# Visual Demands of Text Displays
# [Eye Glance Behavior]

- Total Glance Time required to read message
- Total Number of Glances
- Average Glance Duration
- Average Inter-Glance Interval***

{Button-press (final) glance deleted from all discussion of data}

# Total Glance Time

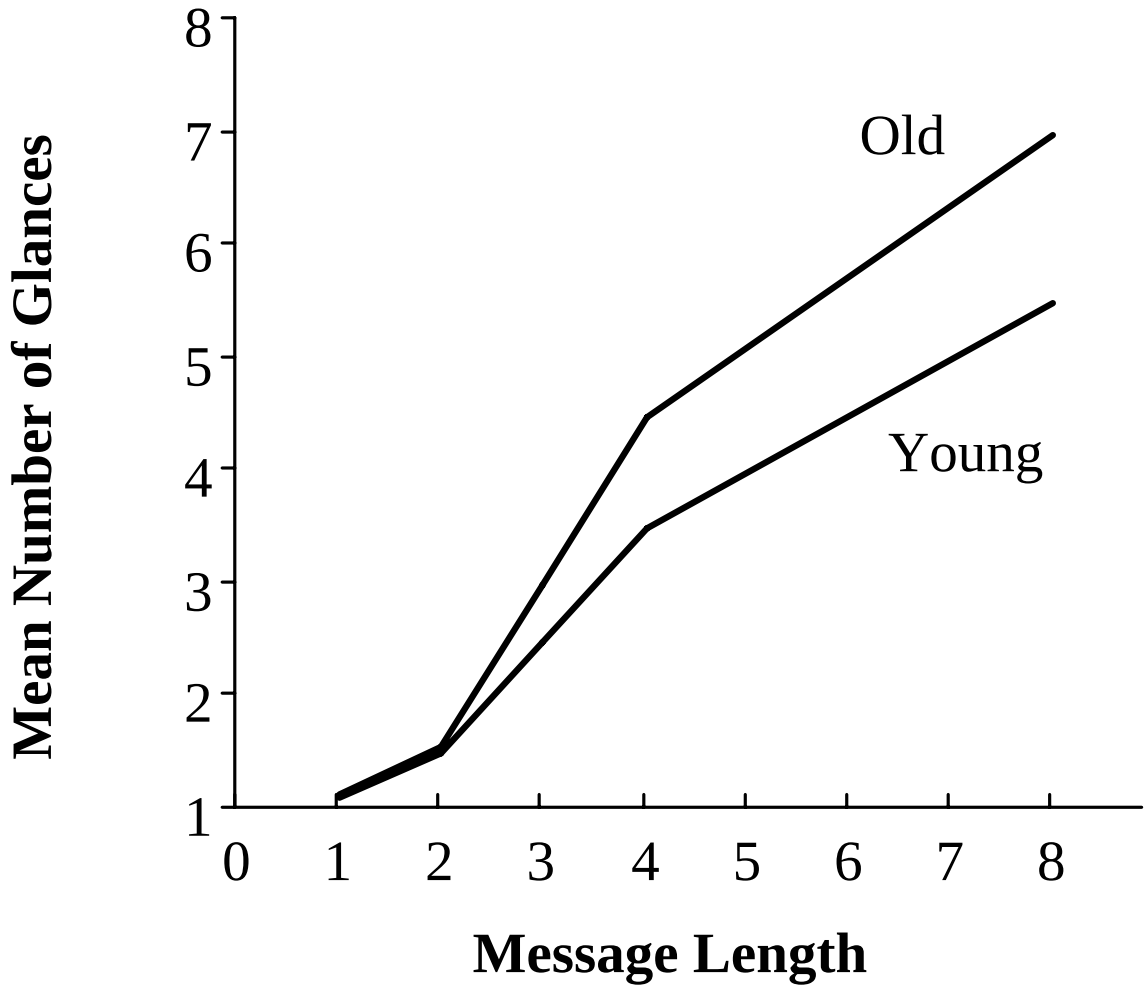



Increases with message length

Rate of increase highest between 1-4 lines; slows thereafter

Age-related increase at message lengths greater than 2 lines

# Number of Glances

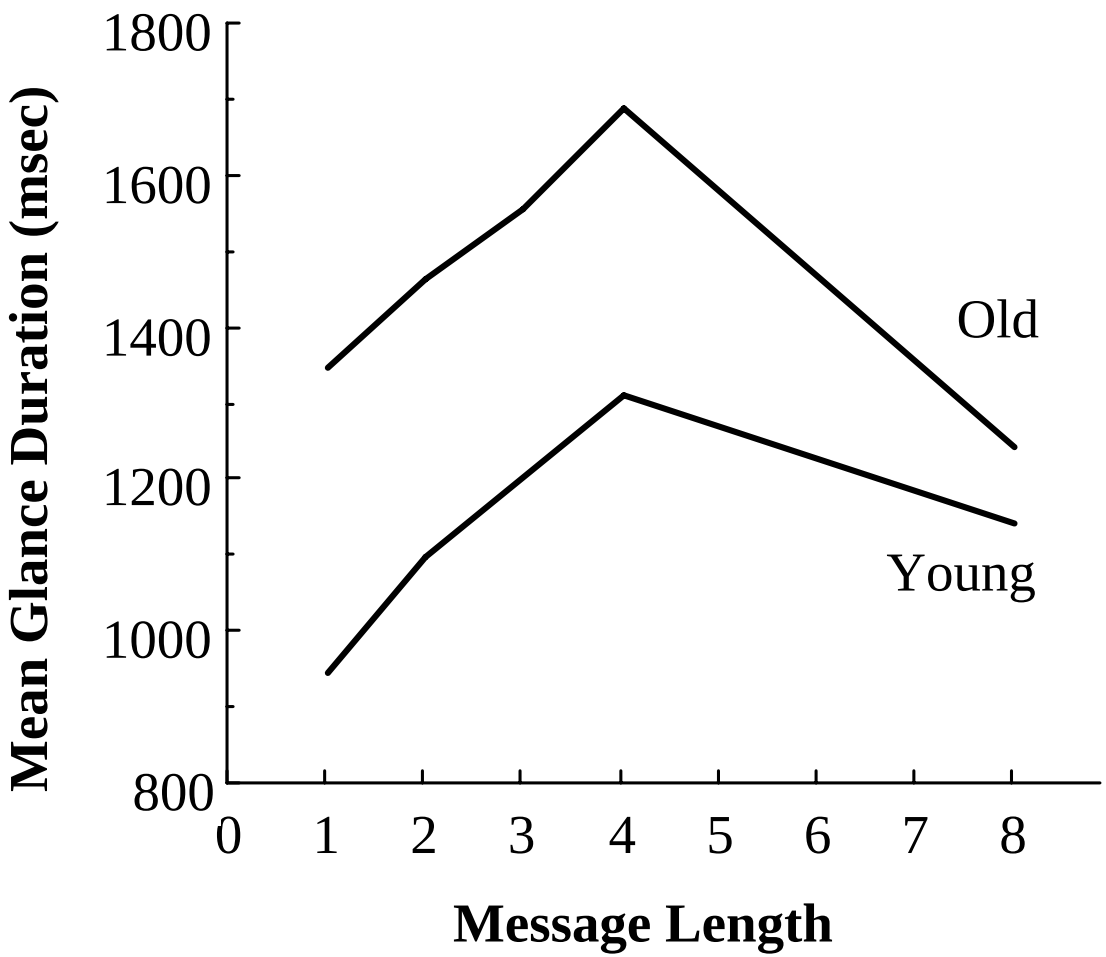



Increases with message length

No age difference for 1-2 line messages

Size of age difference increases as message length grows from 2 to 8

# Average Glance Duration




Older drivers require longer off-road glances

Glance duration per line increases from 1-4 but decreases thereafter (cost of text localization; redundancy at end of a long message)

# Inter-Glance Interval

## "Eyes-on-the-Road" Time

- Visual inspection of video tape records showed that older drivers required much greater "eyes-on-the-road" time between successive glances to the display screen
- Total "real-time to respond" data clearly support an age-related increase in inter-glance interval

# Preliminary Conclusions

- Text messages longer than 2 lines intrude upon simulated driving performance
- On-road/off-road glance time ratio appears to be a promising measure of age differences in visual demand
- Closed-track study of age differences must precede proposed field-studies
- Practice-to-criterion stage needed for future simulation work (with STISIM v. 8.0)

Thank you.

Visit our web page for more information and work-in-progress.

http://www.usd.edu/~schieber