Factors Affecting Glance Behavior when Interacting with In-vehicle Devices: Implications from a Simulator Study

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BACKGROUND

- In-vehicle devices should not induce long off-road glances
  - Secondary tasks may divert drivers' attention from the roadway
  - Individual glances that exceed 2s double the crash risk[1]

STUDY OBJECTIVE

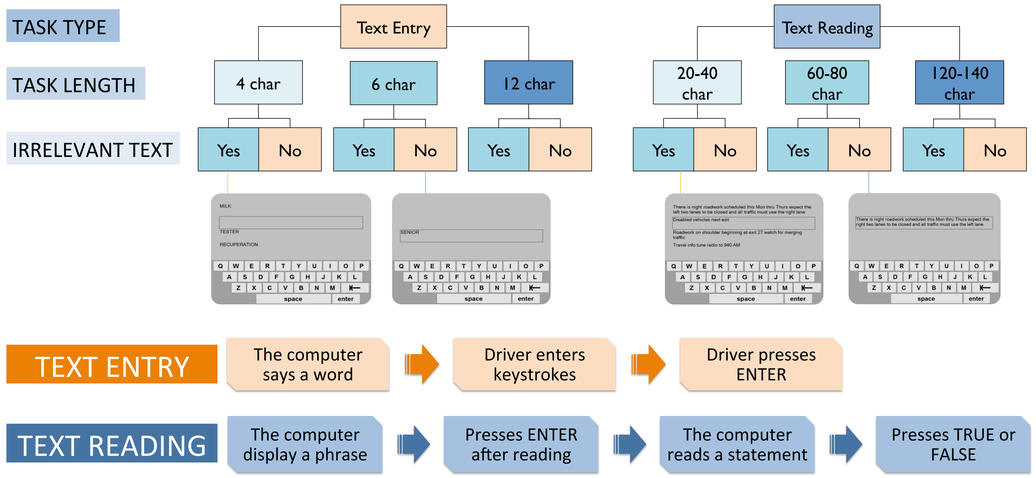
- Examine the impact of in-vehicle task types, text lengths, and the presence of task-irrelevant texts on driver's glance behavior

METHODS

PARTICIPANTS

- 28 participants (15 males, 13 females)
- 4 age groups: 18-24, 25-39, 40-54, 55-75 years old; 7 drivers in each group

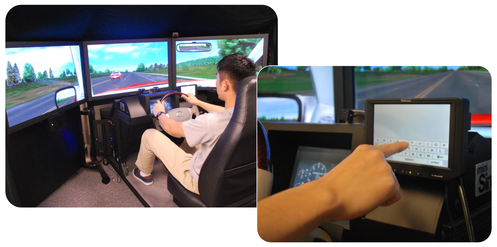
EXPERIMENTAL DESIGN



- Each driver completed three trials of each task condition
- Within-subject independent variables: **Task type, Length**, and **Irrelevant text**
- Repeated measures ANOVAs were used to examine:
  - **Maximum glance duration** (Max-GD): The longest duration of all individual glances during a task
  - **Total eyes-off-road time** (TEORT): The sum of all individual glances during a task

DRIVING SCENARIO

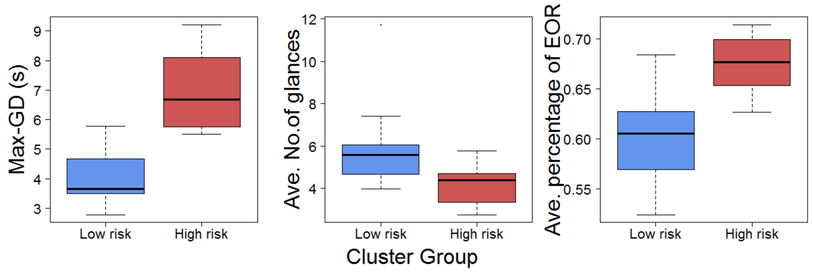
- Four-lane undivided rural road with speed limit of 55 mph
- Drivers were asked to maintain 50 mph and 2-second time headway



RESULTS

DRIVER RISK LEVELS

- Hierarchical cluster analysis using:
  - Maximum glance duration
  - Average no. of glances
  - Average percentage of eyes-off-road (EOR)
- Two clusters
  - High risk (n=8)
  - Low risk (n=20)

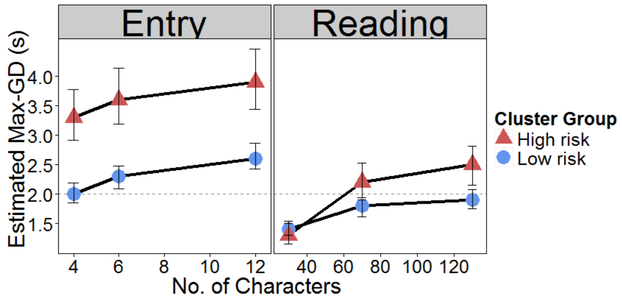


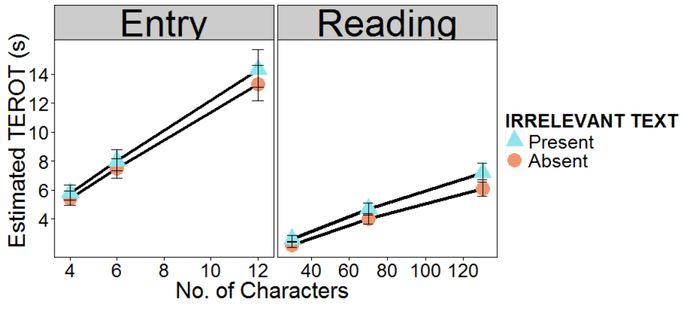
MAXIMUM GLANCE DURATION

- Exceeded 2s even for short text entry tasks and low-risk drivers
- Significantly increased with text length
- However, the increase was not linear
  - No difference between medium (6 char) and long (12 char) length text entry

TOTAL EYES-OFF-ROAD TIME

- Increased linearly as text length increased
- Task-irrelevant text significantly increased TEORT
  - 0.4s to 1.1s longer when irrelevant text was present
- No significant differences between high- and low-risk drivers





DISCUSSION

- Evaluations should consider extreme glance behaviors and individual differences
  - Crash risk might be best represented by extreme glances rather than mean[2]
  - Large individual difference on the MAX-GD may relate to:
    - Risk taking propensity[3]
    - Chunking techniques: Typing several letters at once
- Task-irrelevant text may impact driver's ability to separate text box from clutter of surrounding text
- Shortening the text length does not guarantee safer EOR durations for high-risk drivers
  - Recommendations include designing type-ahead feature and providing real-time alerts

REFERENCES

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ACKNOWLEDGMENTS

This material is based on work supported by the U.S. Dept. of Transportation – NHTSA under Contract No. DTNH22-11-D-00237 (Contracting Officer: Julie Kang).

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