Evaluation of Driving Performance Among Novice Drivers During Reduced Visibility Conditions

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2004 ITE District 1 Annual Meeting
Burlington, Vermont
May 20, 2004
Drivers in Crashes per 100 Licensed Drivers
Massachusetts 2000

Drivers in Crashes per 100 Licensed Drivers

Drivers' Age

Drivers in Crashes by 100 Licensed Drivers

Problem Statement

• 18% of the miles driven by 16 and 17 year-olds takes place between 9:00 P.M. and 5:00 A.M. while 39% of their fatal crashes are reported then.

• Research suggests that inexperience plays a major role in nighttime crashes among teens.

• Little information exists about what skills need training among novice drivers in order to decrease their nighttime crash rate, an evaluation of their driving performance is needed to identify those skills that can be improved by training.
Research Goals

- Identify the need to include nighttime driving training as part of the Graduated Driver Licensing system.

- Evaluate the effects of lighting conditions and drivers’ experience on drivers’ scanning skills and risk perception using a driving simulator.
Research Hypothesis

- Reduced visibility reduces risk perception abilities among novice drivers but have not significant effect on experienced drivers.

- Many of the cues that help drivers predict the presence of a risk are not as easily seen during the night as they are during the day. Younger adults have much less experience on the roads, making it more difficult for them to predict where potential cues might be positioned.
Experimental Design

- Simulation Design
  - 9 virtual scenarios, 3 categories, 2 lighting conditions
  - Scenario counterbalance

- Target & Control Group
  - Young novice drivers (16 and 17 year-olds)
  - Experienced drivers (40-50 year-olds)

- Dependent Variables
  - Fixation of specific areas in the driving environment as a measure of information gathering and risk recognition
  - Advanced cues, critical areas, and critical elements for each scenario
Category 1: Pedestrian

- Advance Cue: Pedestrian Crosswalk Sign
- Critical Area: Sidewalk
- Critical Element: Pedestrian on Left
Category 2: Conflicting Traffic

- Advance Cue: Bicycle Lane Signs
- Critical Area: Opposing Lane
- Critical Element: Bicyclist
Category 3: Traffic Signs/Signal

- Advance Cue: Intersection/Curve Sign
- Critical Area: Intersecting Road
- Critical Element: Entering Traffic
Driving Simulator

- **Hardware**
  - 1995 Saturn Sedan
  - 150 degree of vision in the horizontal direction and 30 degrees in the vertical direction
  - Image resolution: 1024 X 768 dpi with a refresh rate of 60 Hz

- **Software**
  - Designer’s Workbench
  - Real Drive Scenario Builder
Driving Simulator Procedures

- Informed Consent
- Pre Experiment Questionnaire
- Instructions
- Eye Tracker Calibration
- Practice Drive
- Experimental Drives
- Post Experiment Questionnaire
Head Mounted Eye-Tracker

- Integrates eye and head position data to determine point of regard on multiple surfaces in the environment.

- Allows to collect digital data that specifies point of gaze with respect to real objects.

- The real time data is available as moving cursor superimposed on an image of the scene.
Statistical Analysis

- Repeated Measures ANOVA
  - Between subject factor
    - Age (novice & experienced)
  - Within subject factors
    - Lighting condition (daytime & nighttime)
    - Scenario category (Pedestrian, Sign/Signal, Conflicting Traffic)
Results

- Driving Experience
  - ANOVA F(1,46)=27.363, p=0000

- Lighting Condition
  - ANOVA F(1,46)=18.740, p=0000

- Scenario Category (Traffic Situation)
  - ANOVA F(2,92)=14.052, p=0.000
Experience & Lighting Condition

- Experience & Lighting Condition
  - ANOVA $F(1, 46) = .750$, $p = 0.391$
Use and Effectiveness of Critical Elements

Look at critical element and risk: 75.0%
Look at critical element, don't look at risk: 46%
Did not look at critical element, but did look at risk: 29%
Did not look at critical element or risk: 12.5%

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<thead>
<tr>
<th>Percent of Drivers</th>
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<tbody>
<tr>
<td>75.0%</td>
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<tr>
<td>46%</td>
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<td>12.5%</td>
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Young

40-50
Driving experience and reduced visibility are significant factors affecting driving performance.

This study indicates that even with foreshadowing in the daytime, novice drivers visual scanning skills and risk perception skills remain very poor.

Visual scanning skills and risk perception skills are degraded still more during the nighttime.
Recommendations

- The evidence continues to point to the need for training in the relevant visual scanning and risk perception skills.

- There is a need to develop, evaluate, implement and track the effectiveness of risk awareness training programs for novice drivers to maximize the effects of the GDL requirements.
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