INVESTIGATING THE EFFECT OF AREA TYPE AND TRAFFIC CONDITIONS ON Distracted Driving Performance

P. Papantoniou, G. Yannis, C. Antoniou, E. Papadimitriou, D. Pavlou, J. Golias

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• Background
• Objective
• Driving simulator experiment
  – Overview of the experiment
  – Driving at the simulator
  – Experiment design
• Analysis method
  – Driving performance measures
  – Statistical methods
• Results
• Conclusions
• Driving simulators allow for the examination of a range of driving performance measures in a controlled, relatively realistic and safe driving environment

• A driving simulator experiment was carried out within the framework of the Distract and the DriverBrain research projects (national research funding)

**Objective**

The analysis of the effect of area and traffic conditions on driving performance of drivers while talking on the cell phone or conversing with the passenger
• Driving simulator
  – Foerst Driving Simulator (1/4 cab)
• Road environment
  – Rural: 2.1 km long, single carriageway
  – Urban: 1.7 km long, dual carriageway
• Traffic scenarios
  – QL: Low traffic - 300 vehicles/hour
  – QH: High traffic - 600 vehicles/hour
• Unexpected incidents at each trial
  – Child crossing the road
  – Sudden appearance of an animal
Randomization
Randomization was implemented in the order of area type, traffic scenarios as well as distraction scenarios.

Familiarization
The participant practiced in handling the simulator, keeping the lateral position of the vehicle, keeping stable speed, etc.

Sample
- 28 young drivers (18-34)
- 31 middle aged drivers (35-54)
- 36 older drivers (55+)

![Bar chart showing the number of drivers in Trials 1 to 6 for rural and urban areas]

![Pie chart showing the distribution of young, middle aged, and older drivers]
Driving performance measures

- Average speed
- Reaction time an unexpected incident

Statistical analysis method

- Descriptive analysis (box plots)
- Generalized linear models (GLM)
- generalized linear mixed models (GLMM)
Average speed distributions

• Average speed is lower in urban areas than in rural areas both in high and low traffic

• In high traffic the effect of distraction on average speed is less significant

• In low traffic in rural areas, talking on the cell phone leads to reduction in average speed
Reaction time distributions

- Both in rural and urban areas in low traffic conditions distracted driving results to increased reaction time

- In urban areas, reaction time while conversing with the passenger is clearly higher than talking on the cell phone
### Regression analysis – Average speed

<table>
<thead>
<tr>
<th>Variables</th>
<th>Generalised Linear Model</th>
<th>Generalised Linear Mixed Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est.</td>
<td>t value</td>
</tr>
<tr>
<td>Intercept</td>
<td>44,85</td>
<td>111,04</td>
</tr>
<tr>
<td>Distraction - Cell phone</td>
<td>-1,22</td>
<td>-2,82</td>
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<tr>
<td>Age group - Older</td>
<td>-6,15</td>
<td>-14,99</td>
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<tr>
<td>Gender - Male</td>
<td>2,68</td>
<td>7,25</td>
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<tr>
<td>Area type - Urban</td>
<td>-14,54</td>
<td>-39,31</td>
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<tr>
<td>Traffic - Low</td>
<td>3,17</td>
<td>8,64</td>
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</table>

<table>
<thead>
<tr>
<th>Summary statistics</th>
<th>df</th>
<th>Final log-Likelihood</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>-2.584,90</td>
<td>5.183,80</td>
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<tr>
<td></td>
<td>8</td>
<td>-2.396,94</td>
<td>4.809,87</td>
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</tbody>
</table>

- Area type has the highest effect on average speed, as drivers in rural areas drive at the highest speeds, as expected due to the less complex driving environment.
### Regression Analysis – Reaction Time

<table>
<thead>
<tr>
<th>Variables</th>
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<th>Generalised Linear Mixed Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est.</td>
<td>t value</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.546,15</td>
<td>111,04</td>
</tr>
<tr>
<td>Distraction – Passenger</td>
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<td>-2,82</td>
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<tr>
<td>Distraction - Cell phone</td>
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<td>-14,99</td>
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<tr>
<td>Age group - Older</td>
<td>286,30</td>
<td>7,25</td>
</tr>
<tr>
<td>Gender - Male</td>
<td>-181,90</td>
<td>-39,31</td>
</tr>
<tr>
<td>Area type - Urban</td>
<td>-189,01</td>
<td>8,64</td>
</tr>
</tbody>
</table>

| Summary statistics      |          |        |          |        |
| df                      | 7        |        | 8        |        |
| Final log-Likelihood    | -6.121,50 |        | -6.086,52 |        |
| AIC                     | 12.257,00 |        | 12.189,17 |        |

- Male drivers achieved much better reaction times compared to female drivers indicating that they are probably more concentrated and perform quicker in case of an unexpected incident.
CONCLUSIONS (1/2)

• Results indicate that area type has the highest effect on average speed

• The use of a cell phone while driving results in reduced speeds in both environments within the framework of compensatory behaviour

• While talking on the cell phone or conversing with passenger, drivers of all age groups achieved higher reaction times compared with undistracted driving in all conditions
• Young and middle aged drivers achieve higher reaction times when conversing with the passenger than talking on the cell phone.

• Female drivers, especially in rural areas, were found to have the worst reaction times, while being distracted.

• In urban areas, the complex road environment alerts the drivers in order to self-regulate their driving to compensate for any decrease in attention to the driving task.
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