How does distracted driving affect lateral position of older drivers?

P. Papantoniou\(^1\), D. Pavlou\(^1\), C. Antoniou\(^2\), G. Yannis\(^1\), E. Papadimitriou\(^1\)

\(^1\)Department of Transportation Planning and Engineering, NTUA, Athens, Greece
\(^2\)Department of Civil, Geo and Environmental Engineering, TUM, Munich, Germany

*e-mail: ppapant@central.ntua.gr

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Outline

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  • Distraction procedure
• Analysis method
  • Driving performance measure
  • Statistical methods
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Background

- Taking into account that inappropriate lateral positioning is one of the primary factors leading to accidents, lateral control measures are some of the most commonly used driving behaviour metrics.

- Lateral control measures assess how well drivers maintain vehicle position within a lane.

- The most popular measures include:
  - Lateral position
  - Standard deviation of lateral position
  - Steering wheel metrics
Objectives

The analysis of the lateral position of drivers from different age groups, while talking on the cell phone and conversing with another passenger.

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

**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**
- \( Q_L \): Low traffic - 300 vehicles/hour
- \( Q_H \): High traffic - 600 vehicles/hour

**Unexpected incidents at each trial**
- Child crossing the road
- Sudden appearance of an animal
Experiment design

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+)

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Distraction procedure

Distraction sources
• cell-phone conversation
• conversation with passenger

Conversation topics
• Family
• Origin
• Accommodation
• Travelling
• Geography
• Interests
• Hobbies
• Everyday life
• News
• Business
Analysis methods

Driving performance measure
Lateral position - refers to the distance between the simulator vehicle and the right border of the road

Statistical analysis methods
• Descriptive analysis (box plots)
• Generalized linear models (GLM)
• Generalized linear mixed models (GLMM)
Descriptive analysis

Lateral position of drivers is presented per **distraction factor**, per **age group** and per **gender**

- While talking on the cell phone drivers of all age groups have **higher** lateral position compared with undistracted driving.

- These differences are not very clear indicating that **further analysis** should be implemented in order to investigate the specific effect of each parameter on lateral position of the vehicle
### Generalised Lineal Model

| Variables                      | Estimate | Std. Error | t value | Pr(>|t|) |
|-------------------------------|----------|------------|---------|---------|
| Intercept                     | 1.49     | 0.04       | 37.75   | < 0.000 |
| Distraction – Cell phone      | 0.07     | 0.04       | 1.86    | 0.064   |
| Age group – Middle Aged       | 0.19     | 0.04       | 5.17    | < 0.000 |
| Age group – Older             | 0.19     | 0.04       | 4.80    | < 0.000 |
| Area type – Urban             | 1.54     | 0.03       | 50.67   | < 0.000 |
| Traffic – Low                 | -0.11    | 0.03       | -3.57   | < 0.000 |
| Gender – Male                 | -0.10    | 0.03       | -3.26   | 0.001   |

**Summary statistics**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>AIC</td>
<td>989.29</td>
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<tr>
<td>Log-restricted-likelihood</td>
<td>-486.61</td>
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<tr>
<td>Degrees of freedom</td>
<td>810</td>
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</table>

- Lateral position of the vehicle is estimated based on **driver characteristics** such as age group and gender, **road environment characteristics** such as area type and traffic conditions, as well as the use of **cell phone**.
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Generalised Lineal Mixed Model

| Variables                  | Estimate | Std. Error | t value | Pr(>|t|) |
|----------------------------|----------|------------|---------|----------|
| Intercept                  | 1.47     | 0.06       | 24.20   | < 0.000  |
| Distraction – Cell phone   | 0.07     | 0.03       | 2.30    | 0.021    |
| Age group – Middle Aged    | 0.20     | 0.07       | 3.11    | < 0.000  |
| Age group - Older          | 0.32     | 0.06       | 3.19    | < 0.000  |
| Area type - Urban          | 1.53     | 0.03       | 56.71   | < 0.000  |
| Traffic – Low              | -0.10    | 0.03       | -3.97   | < 0.000  |
| Gender – Male              | -0.10    | 0.05       | -1.78   | 0.077    |
| Random effect              |          |            |         |          |
| By Person ID (stdev)       | 0.21     |            |         |          |

Summary statistics
- AIC: 920.51
- Log-restricted-likelihood: -451.26

- Data involve **repeated measures observations** from each individual drive, as each driver completes six drives in rural and six drives in urban environment.
- The likelihood ratio test regarding lateral position \( LR_{\text{lat,pos}} = -70.71 \) (1 degree of freedom) shows that the **random effect** contributes significantly to the fit of the model.
Conclusions

- **Cell phone** use slightly increased lateral position indicating that drivers find difficult to keep the vehicle in a constant distance from the right board of the lane
- **Conversing with a passenger** was not found to affect significantly the lateral position of the vehicle
- **Male** drivers were found to achieve lower lateral position than the female ones
- **Middle aged** and **older** drivers find difficulties in maintaining the driving simulator vehicle compared to young drivers
- **Area type** has the highest effect on lateral position as the urban environment is more complex with much more interactions between vehicles
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