How an unexpected incident affects speed related driving performance measures

P. Papantoniou, D. Pavlou, G. Yannis, E. Vlahogianni
National Technical University of Athens, Iroon Polytechneiou str 8, Athens, GR15773, Greece

Overview

• The objective is to investigate the effect of an unexpected incident on speed related driving performance
• A driving simulator experiment was carried out including 12 unexpected events for each participant
• The effect of several parameters including driver distraction sources (cell phone use, conversation with passenger), driver characteristics (age, gender, driving experience) and road and traffic characteristics is estimated

Experiment design

Sample
The sample of participants is 95 drivers
• 28 young drivers aged 18-34 years old
• 31 middle aged drivers aged 35-54 years old
• 36 older driver aged 55-80 years old

Familiarization
During the familiarization with the simulator, the participants practiced in:
• handling the simulator (starting, gears, wheel handling etc.)
• keeping the lateral position of the vehicle
• keeping stable speed, appropriate for the road environment
• braking and immobilization of the vehicle.
When all criteria the above were satisfied (there was no exact time restriction), the participant moved on to the next phase of the experiment.

Driving scenarios
Road environments:
• A rural route that is 2.1 km long, single carriageway and the lane width is 3m, with zero gradient and mild horizontal curves
• An urban route that is 1.7km long, at its bigger part dual carriageway, separated by guardrails, and the lane width is 3.5m

Traffic scenarios:
• Moderate traffic conditions, corresponding to an average traffic volume Q=300 vehicles/hour
• High traffic conditions, corresponding to an average traffic volume of Q=600 vehicles/hour

Distraction conditions:
• undistracted driving
• driving while conversing with a passenger
• driving while conversing on a mobile phone.

Conversation topics
Family, Origin, Accommodation, Travelling, Geography, Interests, Hobbies, Everyday life, News, Business

Incidents
12 unexpected incidents occurred at fixed Points of each trial (two incidents per trial)

Method of Analysis

• The experiment data storage was performed automatically at the end of each experiment. The simulator recorded data at intervals of 33 milliseconds
• The average value of all driving performance measures was estimated for a time period of 30 seconds before and 30 seconds after the event
• A Generalized Linear Mixed Model (GLMM) is developed where the dependent variable of the model is the difference of average speed before and after the event

Results

| Variables          | Estimate | Std. Error | t value | Pr(>|t|) |
|--------------------|----------|------------|---------|----------|
| Intercept          | -13.152  | 1.583      | -8.305  | < 0.000  |
| Age - Young        | 1.772    | 1.085      | 1.632   | 0.105    |
| Experience         | 0.085    | 0.035      | 2.397   | 0.018    |
| Traffic - Low      | -2.852   | 0.570      | -4.99   | < 0.000  |
| Cell phone use     | 2.212    | 1.303      | -1.69   | 0.090    |

Summary statistics

AIC: 6.616.44
Log-restricted-likelihood: -3.301.22

• Focusing on driver characteristics young drivers tend to change more their speed after an unexpected incident compared to middle aged and older drivers
• Regarding road environment in low traffic conditions speed difference due to the event is lower indicating that after the event is significantly
• More experienced drivers achieve a more compensatory behaviour after the event

Conclusions

• Drivers while talking on the cell phone exhibit in a higher extent compensatory behaviour after an unexpected incident, because the physical presence of a hand-held phone acts as a reminder to the driver of the potential safety threat posed by the use of the phone.
• While conversing with the passenger, driver has a lower level of compensatory behaviour however his attention is more often diverted from the road
• The effect of several driver and road environment characteristics is quantified on the different speeding strategies after an unexpected incident
• The research is essential for policy makers, professionals involved in testing safety systems and those involved in designing and evaluating new driving environments.

Acknowledgement

This paper is implemented within the framework of “IKY Fellowships of Excellence for Post-graduate studies in Greece - Siemens Program”