International Scientific Conference on Mobility and Transport
"TRANSPORTATION SYSTEMS OF THE FUTURE"
11 – 12 September 2019

How an unexpected event affects overall driving performance?

P. Papantoniou[1], G Yannis[2], D. Pavlou[2]

[1]Chair of Transportation Systems Engineering, Technical University of Munich

[2]Department of Transportation Planning and Engineering, National Technical University of Athens

Overview

- The **objective** is to develop a latent variable representing the change in overall driving performance after an unexpected event
- 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 on the difference of overall driving performance

Experiment design

Sample

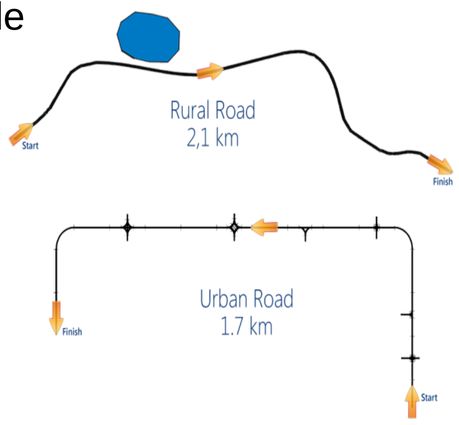
The sample of participants is 95 drivers

- 28 young drivers aged 18-34
- 31 middle aged drivers aged 35-54
- 36 older driver aged 55-80

Driving scenarios

<u>Road environments:</u>

- 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



<u>Traffic scenarios:</u>

- **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

<u>Distraction conditions:</u>

- **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)

Analysis method

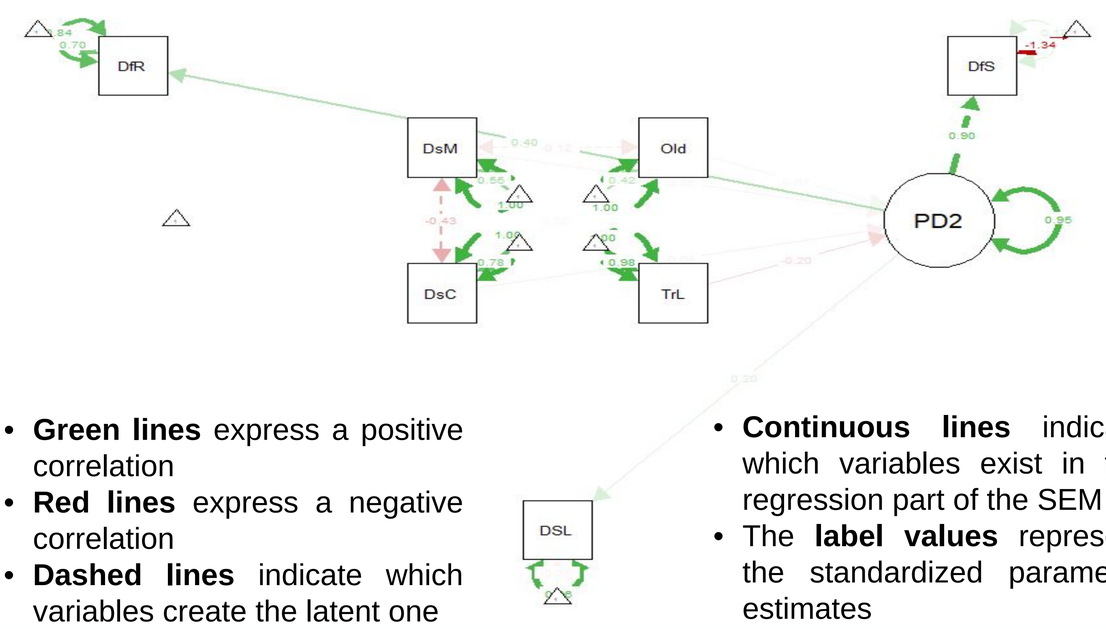
- The **experiment data** storage was performed automatically at the end of each experiment. The simulator recorded data at intervals of 33 milliseconds
- The **average value** of all driving performance measures was estimated for a time period of 15 seconds before and 15 seconds after the event
- A Structural Equation Model (**SEM**) is developed where the dependent variable of the model is the **difference of overall driving performance before and after the event**

Results

Model parameter statistics are summarized in the next table

	Est.	Std.err	t value.	P(>|z|)
Latent Variable				
Dif Driving Performance				
Dif Average Speed	1.000	-	-	-
Dif Stdev Lateral Position	0.003	0.001	3.016	0.003
Dif Rpm	29.225	7.542	3.875	0.000
Regressions				
Dif Driving Performance				
Distraction – Cell phone	-1.075	0.768	-1.399	0.162
Distraction – Passenger	-1.303	0.624	-2.090	0.037
Traffic - Low	-3.156	0.554	-5.700	0.000
Age - Old	1.425	0.767	1.858	0.063
Summary statistics				
Minimum Function Test	26.22			
Degrees of freedom	8			
Goodness-of-fit measure				
SRMR	0.027			

The respective path diagram is presented in the following Figure



- **Green lines** express a positive correlation
- **Red lines** express a negative correlation
- **Dashed lines** indicate which variables create the latent one
- **Continuous lines** indicate which variables exist in the regression part of the SEM
- The **label values** represent the standardized parameter estimates

Conclusions

- The **change of driving performance** (the latent variable) is correlated with the difference of average speed, the difference of the variability of lateral position and the difference of motor revolvation
- Both **distraction factors** were found to negatively affect the latent variable indicating that while conversing with the passenger or talking on the cell phone during an unexpected event, driving performance is less affected after the event
- **Older drivers** especially in **high traffic** were found to change more their driving performance due to an unexpected event
- The effect of several **driver** and r**oad environment characteristics** is quantified on the different speeding strategies after an unexpected incident

Acknowledgement

This research is **co-financed** by the European Union - European Regional Development Fund (ERDF) and Greek national funds through the Operational Program "Competitiveness, Entrepreneurship and Innovation" (EPAnEK) of the National Strategic Reference Framework (NSRF) under the call Research – Create – Innovate. Research Funding Program: **BeSmart** - Multi-modal driver behavior and safety support system on the basis of smartphone applications