National Technical University of Athens
Road Safety Observatory

Workshop
in the framework of

StreetsforLife
#RethinkMobility

WE DEMAND SAFE AND SUSTAINABLE MOBILITY

Friday
19 May
2023
13:00-17:00

7th UN Global Road Safety Week

Road Safety Research Challenges

DECADE OF ACTION FOR ROAD SAFETY 2021 - 2030

unroadsafetyweek.org

Driver-vehicle-environment interactions and safety tolerance zone

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Together with:

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The i-DREAMS project

- 13 Project partners:
  - National Technical University of Athens

    Universiteit Hasselt, Loughborough University, Technische Universität München, Kuratorium für Verkehrssicherheit, Delft University of Technology, University of Maribor, OSeven Telematics, DriveSimSolutions, CardioID Technologies, European Transport Safety Council, POLIS Network, Barraqueiro Transportes S.A.

- Duration of the project:
  - 48 months (May 2019 – April 2023)

- Framework Program:
  - Horizon 2020 - The EU Union Framework Programme for Research and Innovation - Mobility for Growth

Objectives

Development of an integrated model of driver-vehicle-environment interaction and risk by:

- identify the most critical precursors of risk from both the task complexity and the coping capacity side
- implement an integrated model for understanding the effect of the aforementioned inter-relationship with risk
- compare the performance of such models on different countries

Background

Definition, development, testing and validation of a context-aware 'Safety Tolerance Zone':

- raw time-series sensor data and driver background data are transformed into indicators
- operator capacity and task complexity variables are used for a multi-dimensional assessment of driving context and crash risk prediction
- appropriate driver comfort related interventions take place in real-time to recall driver back into a safe area if needed and guidance is given post-trip to improve driving behavior

Task complexity	Risk
Car wipers	Headway map levels
Car high beam	Speeding map levels
Time indicator	Overtaking map levels
Distance	Fatigue map levels
Duration	Harsh acceleration
Month	Harsh braking
Day of the week	Vehicle control events

Coping capacity - vehicle state	Coping capacity – operator state	
Vehicle age	Distance	Inter Beat Interval
First vehicle registration	Duration	Headway
Fuel type	Average speed	Overtaking
Engine Cubic	Harsh acceleration/braking	Fatigue
Engine Horsepower	Forward collision warning	Gender
Gearbox	Pedestrian collision warning	Age
Vehicle brand	Lane departure warning	Educational level

Data Collection

- A naturalistic driving experiment was carried out involving a hundred of drivers from Belgium, Germany and UK and a large database of thousands trips was created
- Data from the Mobileye system, a dash camera and the Cardio gateway which records driving behavior (e.g. speed, acceleration, deceleration, headway) along with GNSS signals were used
- In addition to the vehicle data, questionnaire data were also collected both before and after the trial

Methodology

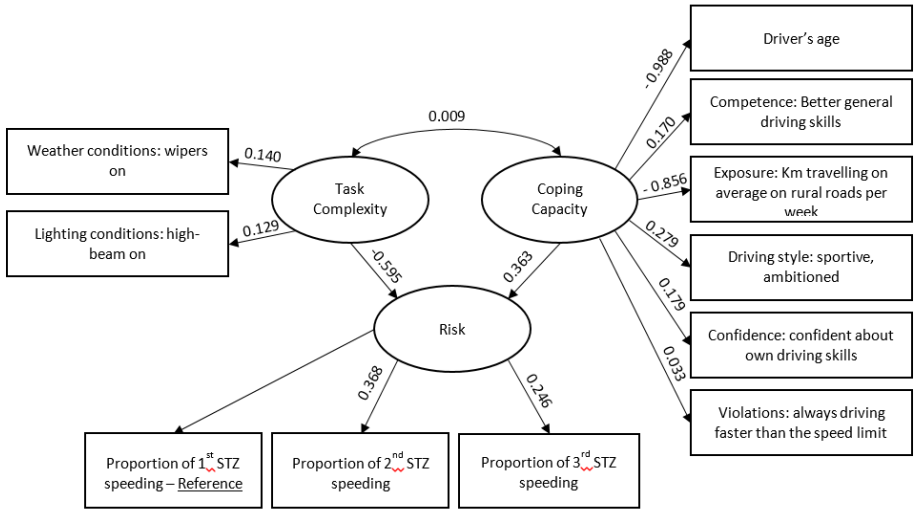
- Structural Equation Modelling (SEM) is widely used for modelling complex and multi-layered relationships between observed (e.g. number of speeding and headway events) and unobserved variables (e.g. crash risk)
- Observed variables are measurable, whereas unobserved variables are latent constructs
- The SEM is used to explore how the model variables are inter-related, allowing for both direct and indirect relationships to be modelled
- These models are often represented by a path analysis, showing how a set of 'explanatory' variables can influence a 'dependent' variable

Results

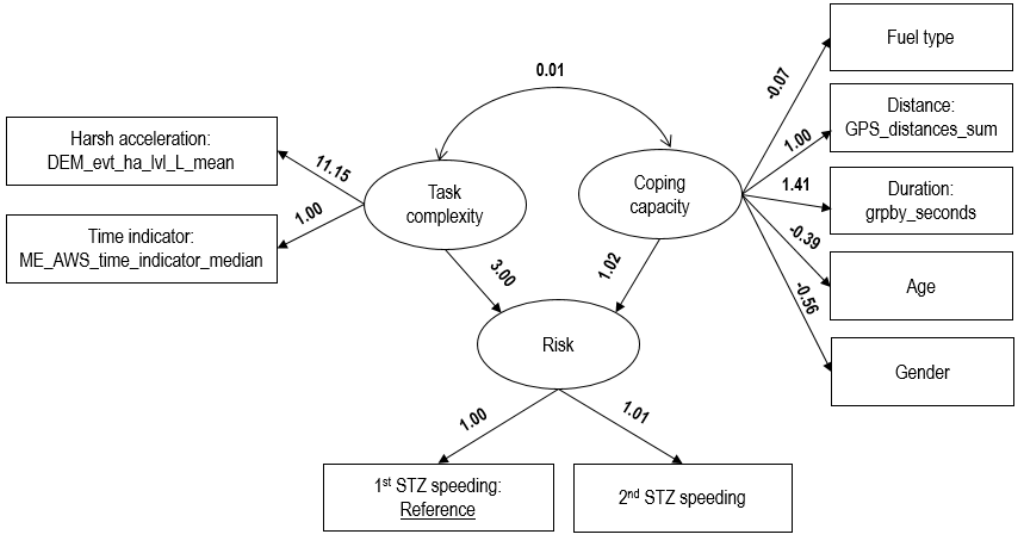
- For the majority of the risk factors investigated, it was found that higher task complexity levels lead to higher coping capacity with the drivers. This means that drivers, when faced with difficult conditions, tend to regulate well their capacity to apprehend potential difficulties, while driving

- When looking into the relationship among the interaction of task complexity and coping capacity and its effect on risk, in Belgium and Germany, the influence of task complexity on risk was greater than the effect of coping capacity. Mixed results were observed in the UK

- The comparison of models fitted on data from the different phases of the experiments, validated that in the majority of the countries the interventions had a positive influence on risk compensation, increasing the coping capacity of the drivers and reducing the risk of dangerous driving behaviour



Experiment Phase 1 - Belgium



Experiment Phase 4 - Germany

Streets for Life

- The i-DREAMS system itself can directly improve safety once launched, but also additional safety benefits can be envisaged in the medium and long term as it is built on and further adapted to different contexts and industry needs, thanks to its modular nature

- The integrated treatment of task complexity, coping capacity and risk can improve behavior and safety of all travelers and all transport modes, through the unobtrusive and seamless monitoring of behaviour

- Authorities may use data systems at population level to plan mobility and safety interventions, set up road user incentives, optimize enforcement and enhance community building on safe travelling

Scientific and Social Impact

- Enhanced road safety for a diverse demographic by increasing consideration of human factors within designs and transport operation means
- Improved operator's driving performance and skills through the close and interactive monitoring and assessment of their driving behavior
- Enhanced international cooperation concerning human factors in traffic safety
- Policy recommendations for Authorities on how to exploit the i-DREAMS platform to improve safety

Future Challenges

- Expansion of the Safety Tolerance Zone to other modes and users (Powered Two Wheelers, cyclists, pedestrians)
- Real-time investigation of the significant risk factors (e.g. weather, seat belt, drug abuse or alcohol consumption)
- Modification of Safety Tolerance Zone to ensure safer automated vehicles
- Additional methodologies could be explored for the understanding of the relationship between task complexity, coping capacity and crash risk
- Factor analysis and microscopic data analysis of the database collected could be implemented through econometric techniques and deep learning

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