RSS2019 ROAD SAFETY & SIMULATION INTERNATIONAL CONFERENCE

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Transformations in Transportation

THE UNIVERSITY OF IOWA

THE NATIONAL ADVANCED DRIVING SIMULATOR

Driving anger: Emerging issues and opportunities to advance the safety science

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Outline

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- **Methodology**
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Driving Anger

Driving anger

- is defined as the **aggressive** or angry behaviour of a driver
- includes rude gestures, verbal insults and deliberately **dangerous** or threatening driving
- can lead to quarrels, attacks and **conflicts** that cause injuries or even fatalities

Driving Anger Expression Inventory

is a widely used, valid and representative **tool** for measuring the expression of driving anger

Driver behaviour experiments

The following **experiment types** of assessing driving behaviour exist:

- **Driving simulator** experiments
- **Naturalistic driving** experiments
- **On road** experiments
- **Questionnaire** surveys (stated preference analysis)

- The decision regarding which experimental type to implement should be guided by the specific **research question**

- All types of experiments should carefully follow some basic **experimental design principles**, allowing for reliable analysis of the data

Objective

To investigate the **effect of anger on driver behaviour and safety** using a driving simulator experiment and self-reported questionnaires

A driving simulator experiment was carried out within the framework of the **Distract** and the **DriverBrain** research projects by an interdisciplinary research team consisting of:

- **Neurologists** - Medical/neurological assessment
- **Neuropsychologists** - Neuropsychological assessment:
- **Transportation Engineers** - Driving at the simulator

distrACT
driverBRAIN

Department of Transportation Planning and Engineering, NTUA

Department of Neurology, Psychiatry and Social Medicine, UoA
Department of Psychology, UoA

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


Too slow

Experiment design

Randomization

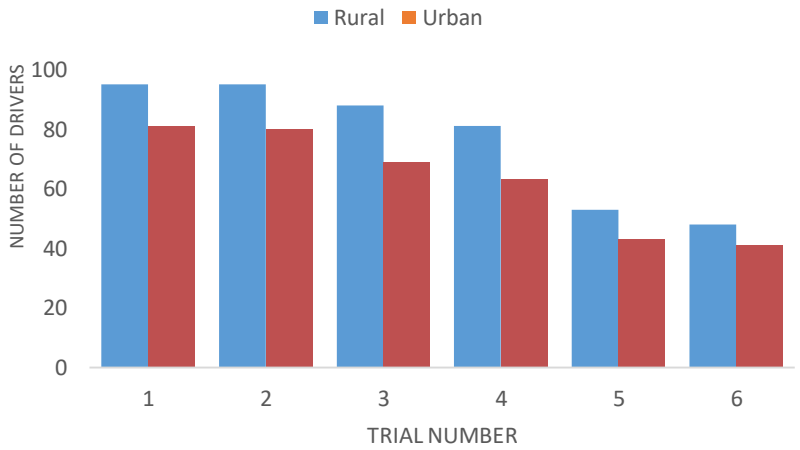
Randomization was implemented in the order of area type, traffic scenarios as well as distraction scenarios

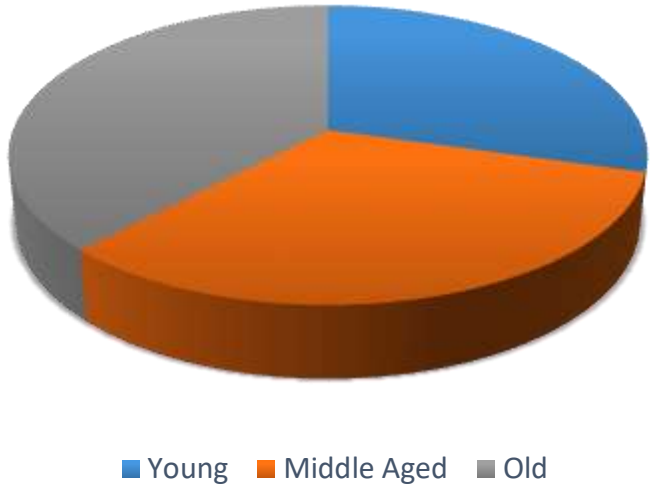
Familiarization

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+)





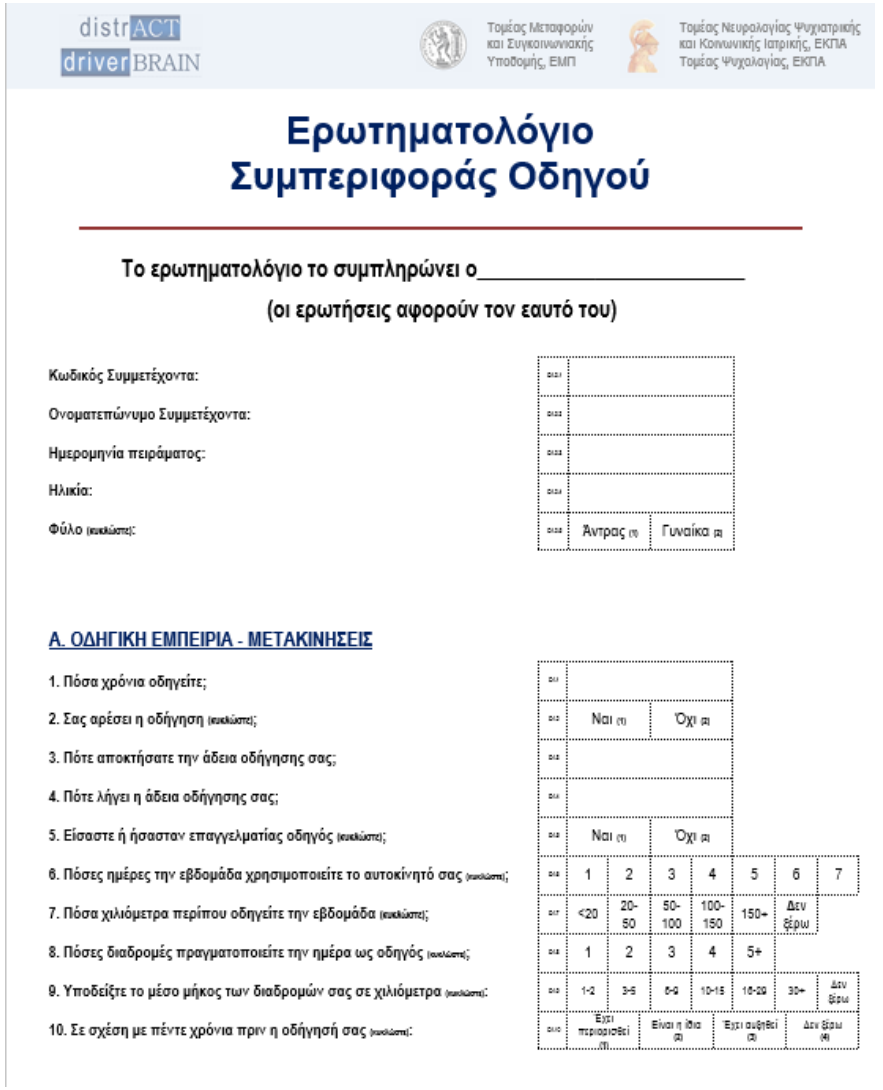
Medical Assessment

- The **Neurological assessment** concerned the administration of a full medical, clinical and neurological evaluation and taking of a detailed background history of all the participants, in order to identify the existence of disorders
- The **neuropsychological assessment** included a detailed screening of various cognitive domains with the use of appropriate tools. The elected neuropsychological tests covered a large spectrum of cognitive functions:

Cognitive Domain	Tests
Global Cognitive Status	Mini Mental State Examination, Montreal Cognitive Assessment test
Verbal Memory and Learning	The Hopkins Verbal Learning Test - Revised
Verbal Working Memory	Letter Number Sequencing task - Wechsler Adult Intelligence Scale-IV
Visual Scanning and Spatial Memory and Learning	The Brief Visuospatial Memory Test-Revised Driving Scenes Test - Neuropsychological Assessment Battery
Visuospatial Perception	Line Orientation Test - Repeatable Battery of Neuropsychological Screening, Clock Drawing Test
Visuospatial Working Memory	Spatial Span Task - Wechsler Memory Scale Driving Scenes Test - Neuropsychological Assessment Battery
Constructional ability	Clock Drawing Test
Attention/Information Processing Speed/Perception	Trail Making Test - part A, Comprehensive Trail Making Test, Symbol Digit Modalities Test, Useful Field of View, Witkin's - Embedded Figures Test
Selective and Divided Attention	Useful Field of View Driving Scenes Test-Neuropsychological Assessment Battery
Executive Functions	Frontal Assessment Battery, Trail Making Test-part B, Spatial Addition Task - Wechsler Memory Scale, Clock Drawing Test
Psychomotor vigilance	Psychomotor Vigilance Test

Driving behaviour questionnaire

- Driving experience - car use
- Self - assessment of the older driver
- Distraction-related driving habits
- Emotions and behaviour of the driver
- **Anger expression inventory during driving**
- History of accidents, near misses, and traffic violations



distrACT driverBRAIN

Τομέας Μεταφορών και Συγκοινωνιακής Υποδομής, ΕΜΠ

Τομέας Νευρολογίας Ψυχιατρικής και Κοινωνικής Ιατρικής, ΕΚΠΑ
Τομέας Ψυχολογίας, ΕΚΠΑ

Ερωτηματολόγιο Συμπεριφοράς Οδηγού

Το ερωτηματολόγιο το συμπληρώνει ο_____

(οι ερωτήσεις αφορούν τον εαυτό του)

Κωδικός Συμμετέχοντα:

Ονοματεπώνυμο Συμμετέχοντα:

Ημερομηνία πειράματος:

Ηλικία:

Φύλο (κυκλώστε): Άντρας (1) Γυναίκα (2)

Α. ΟΔΗΓΙΚΗ ΕΜΠΕΙΡΙΑ - ΜΕΤΑΚΙΝΗΣΕΙΣ

1. Πόσα χρόνια οδηγείτε;
2. Σας αρέσει η οδήγηση (κυκλώστε): Ναι (1) Όχι (2)
3. Πότε αποκτήσατε την άδεια οδήγησης σας;
4. Πότε λήγει η άδεια οδήγησης σας;
5. Είσαστε ή ήσασταν επαγγελματίας οδηγός (κυκλώστε): Ναι (1) Όχι (2)
6. Πόσες ημέρες την εβδομάδα χρησιμοποιείτε το αυτοκίνητό σας (κυκλώστε): 1 2 3 4 5 6 7
7. Πόσα χιλιόμετρα περίπου οδηγείτε την εβδομάδα (κυκλώστε): <20 20-50 50-100 100-150 150+ Δεν ξέρω
8. Πόσες διαδρομές πραγματοποιείτε την ημέρα ως οδηγός (κυκλώστε): 1 2 3 4 5+
9. Υποδείξτε το μέσο μήκος των διαδρομών σας σε χιλιόμετρα (κυκλώστε): 1-2 3-5 6-9 10-15 16-29 30+ Δεν ξέρω
10. Σε σχέση με πέντε χρόνια πριν η οδήγησή σας (κυκλώστε): Έχει περιορισθεί (1) Είναι η ίδια (2) Έχει αυξηθεί (3) Δεν ξέρω (4)

Analysis results (1/2)

A **factor analysis** was performed in order to reduce the number of independent variables related to anger

The 4 factors identified as the optimal solution are the following:

- **external anger**
- **forgiveness**
- **internal anger**
- **noble-mindedness**

Relatively high correlations appeared between the anger factors and several independent variables such as Age, Gender, Education and Driving experience

Factor 1: External Anger	Loadings	Coefficients
I try to cut in front of the other driver	0.753	0.174
I make negative comments about the other driver	0.747	0.138
I glare at the other driver	0.747	0.170
I think things like “Where did you get your license?”	0.734	0.140
I give the other driver the finger	0.676	0.100
I swear at the other driver aloud	0.674	0.128
I shake my head at the other driver	0.663	0.145
I make hostile gestures other than giving the finger	0.639	0.102
Factor 2: Forgiveness		
I pay even closer attention to being a safe driver	0.724	0.197
I think about things that distract me from thinking about the other driver	0.644	0.172
I do things like take deep breaths to calm down	0.638	0.175
I try to think of positive solutions to deal with the situation	0.625	0.161
I turn on the radio or music to calm down	0.584	0.190
I just try to accept that there are bad drivers on the road	0.576	0.149
I decide not to stoop to their level	0.504	0.082
Factor 3: Internal Anger		
I don’t accept that there are frustrating situations while driving	0.674	0.223
I break out to others later	0.667	0.245
I drive a little faster than I was	0.643	0.192
I go crazy behind the wheel	0.554	0.191
I break out to fellow passengers	0.534	0.165
Factor 4: Noble-Mindedness		
I don’t try to scare the other driver	0.911	0.350
I don’t drive right up on the other driver’s bumper	0.911	0.350
I tell myself it’s not worth getting involved in	0.651	0.202
I decide not to stoop to their level	0.596	0.179

Analysis results (2/2)

- The **multiple linear regression** method was chosen for continuous variables
- The method used for the discrete variables was **generalized ordinal logistic** regression correspondingly
- 5 regression models have been developed

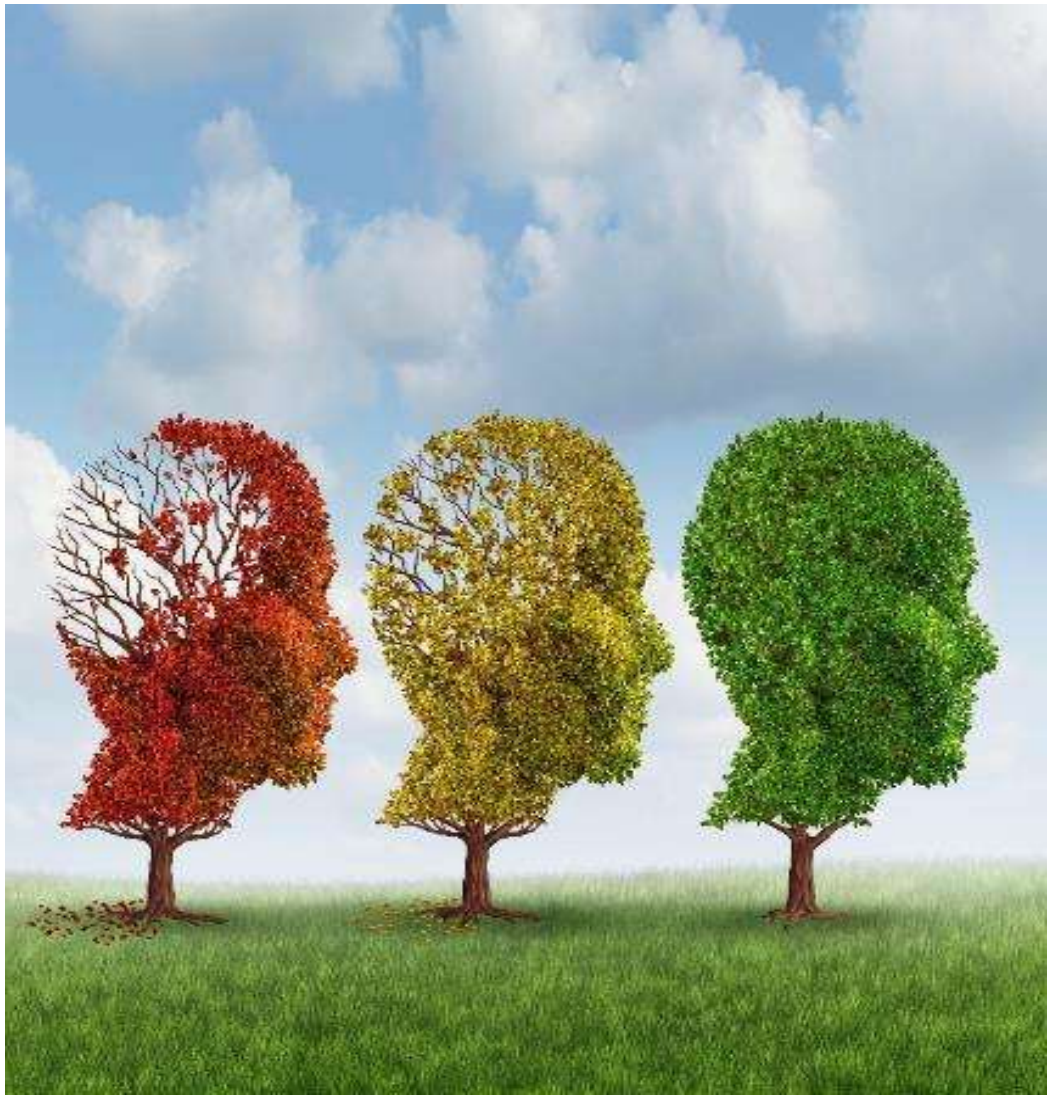
$$Av.Speed = 48.9 + 2 * (Ext.Anger) - 2.1 * (Forgiveness)$$
$$Avg.Time\ Headway = 43.8 - 5.1 * (Ext.Anger) + 6.1 * (Forgiveness)$$
$$P(Speed > Limit) = \frac{1}{1 + e^{1.3 - \{0.5 * (Ext.Anger) - 0.94 * (Forgiveness)\}}}$$
$$P(Accidents > 0) = \frac{1}{1 + e^{-1.68 - \{-0.84 * (Forgiveness)\}}}$$
$$P(Ticket > 0) = \frac{1}{1 + e^{0.59 - \{0.74 * (Ext.Anger) - 0.49 * (Noble - Mindedness)\}}}$$

Conclusions

- Driving anger is a **multidimensional phenomenon** which means that no single driving performance measure/experimental methodology can capture all effects of anger
- The influence of driving anger on the **average speed**, the probability of **violating** the speed limit and the number of **road traffic violations** were confirmed
- The association of anger with **driver characteristics** (age and gender) was quantified

Future challenges

- A different **driving assessment** of the effects of anger with the use of more objective sources (e.g. police/insurance reports, in car driver monitoring in realistic conditions)
- Examination of drivers' reactions the **moment** they appear to be in anger are essential for a deeper understanding of the mechanism of anger in driving
- Investigation of **intervention strategies** to eliminate the adverse effects of anger while driving



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