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

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Outline

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- **Objective**
- **Methodology**
  - Driving simulator experiment
  - Neurological assessment
  - Neuropsychological tests
  - Questionnaires
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- **Conclusions**
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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
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
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**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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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:

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<tr>
<th>Cognitive Domain</th>
<th>Tests</th>
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<tr>
<td>Global Cognitive Status</td>
<td>Mini Mental State Examination, Montreal Cognitive Assessment test</td>
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<td>Verbal Memory and Learning</td>
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<td>Verbal Working Memory</td>
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<td>Visual Scanning and Spatial</td>
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<td></td>
<td>Driving Scenes Test - Neuropsychological Assessment Battery</td>
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<td>Constructional ability</td>
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<td>Attention/Information Processing</td>
<td>Trail Making Test - part A, Comprehensive Trail Making Test, Symbol</td>
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<td>Speed/Perception</td>
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<td>Selective and Divided Attention</td>
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<td>Executive Functions</td>
<td>Frontal Assessment Battery, Trail Making Test-part B, Spatial</td>
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<td></td>
<td>Addition Task - Wechsler Memory Scale</td>
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<tr>
<td>Psychomotor vigilance</td>
<td>Psychomotor Vigilance Test</td>
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</table>
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
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.
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.

\[
\text{Av. Speed} = 48.9 + 2 \times (\text{Ext. Anger}) - 2.1 \times (\text{Forgiveness})
\]

\[
\text{Avg. Time Headway} = 43.8 - 5.1 \times (\text{Ext. Anger}) + 6.1 \times (\text{Forgiveness})
\]

\[
P(\text{Speed} > \text{Limit}) = \frac{1}{1 + e^{1.3 - (0.5 \times (\text{Ext. Anger}) - 0.94 \times (\text{Forgiveness}))}}
\]

\[
P(\text{Accidents} > 0) = \frac{1}{1 + e^{-1.68 - (-0.84 \times (\text{Forgiveness}))}}
\]

\[
P(\text{Ticket} > 0) = \frac{1}{1 + e^{0.59 - (0.74 \times (\text{Ext. Anger}) - 0.49 \times (\text{Noble-Mindedness}))}}
\]
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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