How an unexpected event affects overall driving performance?

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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
- 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 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)

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:

| Latent Variable                  | Est   | Std.err | t.value | P>|>|2|<|<|<|<|<|<|<|
|---------------------------------|-------|---------|---------|----------|
| 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    |

<table>
<thead>
<tr>
<th>Regressions</th>
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<tbody>
<tr>
<td>Dif Driving Performance</td>
<td></td>
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<tr>
<td>Distraction – Cell phone</td>
<td>-1.075</td>
<td>0.768</td>
<td>-1.399</td>
<td>0.162</td>
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<tr>
<td>Distraction – Passenger</td>
<td>-1.303</td>
<td>0.624</td>
<td>-2.090</td>
<td>0.037</td>
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<td>Traffic – Low</td>
<td>-3.156</td>
<td>0.554</td>
<td>-5.700</td>
<td>0.000</td>
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<tr>
<td>Age - Old</td>
<td>1.425</td>
<td>0.767</td>
<td>1.858</td>
<td>0.063</td>
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</tbody>
</table>

Summary statistics
- Minimum Function Test: 26.22
- Degrees of freedom: 8
- Goodness-of-fit measure: 0.027
- SRMR: 0.027

The respective path diagram is presented in the following Figure:

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 revoluation.
- 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 road environment characteristics is quantified on the different speeding strategies after an unexpected incident.

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