Naturalistic Distraction and Driving Safety in Older Drivers


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Seminar: Language Comprehension and Aging
Saarland University
Overview

- Introduction
- Methods and materials
- Results
- Summary
- Discussion
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"What did you do yesterday?"

Ohh! You forgot the traffic sign!
What do you think about who has more fatal crashes: middle-aged or older drivers?

Video
Motivations

- The increase of the percentage of older drivers who are at greater risk for fatal crashes

Question to solve:

- Are there other factors, different as visual acuity, that can influence the driving performance in middle-aged and older drivers during a naturalistic distraction?
Multitasking: naturalistic distraction

Middle-aged
Older drivers

Multitasking

Performance in visual search for roadside targets

Concurrent driving safety

Prediction of older drivers’ performance (visual, motor and cognitive domains)

Landmarks

Traffic signs
Overview

- Introduction
- **Methods and materials**
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## How the experiment was conducted?

### Participants

<table>
<thead>
<tr>
<th>Category</th>
<th>Participants</th>
<th>Ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older drivers</td>
<td>61 men, 59 women, 120 in total</td>
<td>Ages 65 to 89 years</td>
</tr>
<tr>
<td>Middle-aged drivers</td>
<td>38 men, 45 women, 83 in total</td>
<td>Ages 40 to 65 years</td>
</tr>
<tr>
<td>Recruited</td>
<td>From local community through public service announcements and advertisements in newspapers, senior centers, and churches.</td>
<td></td>
</tr>
</tbody>
</table>
# How the experiment was conducted?

## Landmark and Traffic Sign Identification Test (LTIT)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Driving</th>
<th>Experimental performance data</th>
<th>Frequency and safety errors</th>
</tr>
</thead>
</table>
| - ARGOS (Automobile for Research in Ergonomics and Safety)  
  - Ford Taurus  
  - Multiple road and Challenges | - 45 min  
  - 1.5 miles  
  - Speed: 30 – 45 mph  
  - Research assistant | - Verbal question  
  - Traffic sign: 16  
  - Restaurant: 13  
  - A four-view video | - 76 error types  
  - Vehicle speed, acceleration and steering wheel |

![Car interior with steering wheel and speedometer](image1)

![Driver's view with video recordings](image2)
Off-Road Testing Battery
Neuropsychological tests

Information: demographic, familiarity, driving habits questionnaire (DHQ).

Motor: tests of motor abilities. The Get-Up-and-Go test appears to predict an elderly individual’s ability to safely go outside alone.

Visual: the ability to resolve details in low light conditions. Drivers with poor contrast sensitivity (Pelli–Robson chart) may have difficulty seeing low contrast vehicles, particularly at night or in wet weather.

Cognitive: the tests that require visual processing of information: lower-order visual perception (Judgment of Line Orientation) and higher-order visual cognition (Complex Figure Test–Copy).

Executive function refers to abilities necessary for planning and organizing (Trail Making Tests).

For measuring the Verbal memory was used the Auditory–Learning Verbal Test–Recall.
Which are the cognitive abilities require for safe driving?

**Visual Selective Attention**
How well a person can select and attend to relevant information

**Processing speed**
How quickly a person can comprehend a situation and take the relevant information

**Executive function**
The capacity to use all relevant information to plan a response, and to use higher level thinking strategies

**Visual search**
The ability to scan a scene for vital information

**Reaction time**
The time it takes to respond to a stimulus (It can be measured in foot or hand)

**Working memory**
The capacity to hold information in mind while processing it (the capacity to ‘dual task’)
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Comparisons of Predictor Variables Between Middle-aged and Older Drivers

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Middle-Aged Drivers</th>
<th>Older Drivers</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M (SD)</td>
<td>n</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>83</td>
<td>57.28 (6.70)</td>
<td>120</td>
</tr>
<tr>
<td>Education (years)</td>
<td>83</td>
<td>15.63 (2.31)</td>
<td>120</td>
</tr>
<tr>
<td>Driving characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miles per week</td>
<td>83</td>
<td>131.82 (116.42)</td>
<td>120</td>
</tr>
<tr>
<td>Days per week</td>
<td>83</td>
<td>6.08 (1.35)</td>
<td>120</td>
</tr>
<tr>
<td>Familiarity (yes and somewhat)</td>
<td>82</td>
<td>87.80%</td>
<td>110</td>
</tr>
<tr>
<td>Basic vision</td>
<td>83</td>
<td>0.35 (0.59)</td>
<td>120</td>
</tr>
<tr>
<td>Motor</td>
<td>83</td>
<td>0.36 (0.53)</td>
<td>120</td>
</tr>
<tr>
<td>Visual perception</td>
<td>83</td>
<td>0.28 (0.60)</td>
<td>120</td>
</tr>
<tr>
<td>Visual cognition</td>
<td>83</td>
<td>0.20 (0.70)</td>
<td>120</td>
</tr>
<tr>
<td>Verbal memory (AVLT-Recall)</td>
<td>83</td>
<td>11.28 (2.87)</td>
<td>120</td>
</tr>
<tr>
<td>Executive function</td>
<td>83</td>
<td>0.25 (0.73)</td>
<td>120</td>
</tr>
<tr>
<td>Overall cognition (COGSTAT)</td>
<td>83</td>
<td>429.12 (40.87)</td>
<td>120</td>
</tr>
</tbody>
</table>

- **Predictor variable:** Demographics, driving characteristics and neuropsychological test
- **Outcome:** Performance in landmark, traffic sign identification and concurrent driver safety errors
- **The older drivers** performed worse on all domains of functioning, including basic vision, Motor and cognition, compared with the middle-aged drivers.
Older drivers identified fewer restaurants – no significant disadvantage with respect to sign identification

The older drivers drove at lower speeds and had lower average lateral and longitudinal accelerations but the older drivers committed more safety errors.
Most safety errors involved lane changes, lane observance, turns, and turn signals.

Older adults but not younger adults were observed to show speed control errors and to drive slower than 10 miles below the posted speed limit.
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To Summarize

- Cognitive aging is associated with declines in many of the functions necessary for **safely operating** a motor vehicle.

- Cognitive functioning, particularly, executive function and visual cognition predicted driver performance over and above vision, among healthy older adults.

- Older drivers identified fewer landmarks, drove slower and committed more **safety errors** compared with middle-aged drivers.

- Greater **familiarity** benefited middle-aged but **not older adults’** performance.
Recommendations

- Results have implications for designing on-road tests for older drivers and supporting cognitive testing.

- It is required to find creative ways of implementing and quantifying performance in specific driving tasks in the real world, which are typically tested in simulator studies.

- Development of training programs including competent use of GPS devices to support safe wayfinding by older drivers.
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Discussion

- According to the four cognition domains (visual perception, visual cognition, verbal memory and executive function), which of them do you find more relevant in the case of middle-aged and older drivers for driving safety?

- Do you think that the age should consider as a restriction factor for driving licensing or other factors have to be taken into account?

- Would be convenient to have available special traffic signs and artificial landmarks for older drivers in contrast of the conventional ones?
References


- http://www.uiowa.edu/~neuroerg/argos.html, visited on 25.01.2015


Thank you