Ageing and processing of irrelevant information in a Driving-Like Dual Task

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AGE-RELATED CHANGES

• Sensory skills

• Motor skills

• Cognitive (executive) functions:
  - Visual search
  - Switching and dividing of attention
  - Inhibition of irrelevant information and inappropriate responses
  - Coordination of multiple tasks

>>> Highly relevant for car driving!
Experiment 1

**DRIVING-LIKE DUAL TASK**

a) Compensatory Tracking  
b) Visual Attention Task (VISATT)

**Participants:**

25 young (20-33 years, Ø 25.2 years, 12 male)  
24 older (57-70 years, Ø 64.5 years, 12 male)

**EEG:**

59 electrodes + hEOG / vEOG  
500 Hz sampling rate
**Experiment 1**

**COMPENSATORY TRACKING TASK**

Task:
Compensate “sidewind” by rotating the steering wheel and avoid red bars

horizontally moving green bar

red bar = too much deviance!
**VISUAL ATTENTION TASK (VISATT)**

**Task:**

Respond to relevant targets (= predefined target letters) that are on the same position as the previous cue, with a left or right button press, do this as fast and correct as possible.
**VISUAL ATTENTION TASK (VISATT)**

4 Conditions:

<table>
<thead>
<tr>
<th>Position</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>same as cue</td>
<td>contrary to cue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target Letter</th>
<th>Relevant Target 40%</th>
<th>Irrelevant Target 20%</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Non-Target Letter</th>
<th>Relevant Non-Target 20%</th>
<th>Irrelevant Non-Target 20%</th>
</tr>
</thead>
</table>
VISUAL ATTENTION TASK (VISATT)

4 Conditions:

<table>
<thead>
<tr>
<th>GO</th>
<th>Position same as cue</th>
<th>Position contrary to cue</th>
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</table>
VISUAL ATTENTION TASK (VISATT)

4 Conditions:

**GO**
- Position same as cue
  - Target Letter: Relevant Target 40%
  - Non-Target Letter: Relevant Non-Target 20%

- Position contrary to cue
  - Target Letter: Irrelevant Target 20%
  - Non-Target Letter: Irrelevant Non-Target 20%

**NOGO**
VISUAL ATTENTION TASK (VISATT)

4 Conditions:

- **GO**
  - Target Errors
  - Missings
  - **Target Letter**
    - Position same as cue: Relevant Target 40%
    - Position contrary to cue: Irrelevant Target 20%
  - **Non-Target Letter**
    - Relevant Non-Target 20%
    - Irrelevant Non-Target 20%

- **NOGO**
  - False Alarms
DATA ANALYSIS

- Performance data tracking (RMSE)
- Performance data VISATT (RT, error rates)
- EEG data VISATT (P300, CNV)
Experiment 1

RESULTS TRACKING

The absolute tracking error was higher in old (16.5%) vs. young subjects (13.7%). The relative tracking error varied due to the phase of the secondary task: In the preparation phase before the letters tracking improves for the older subjects, while it deteriorates after target letters mainly for the older subjects.
RESULTS VISATT

Are there age-related differences in VISATT-performance?

![Graphs showing response time and error rates for young and old participants.](image)
CNV AND P3 – PROCESSING OF CUES AND PREPARATION

Older subjects process the cue stimuli more intensely (P3) and had a larger CNV during preparation. The CNV amplitude correlated with the rate of missed targets in the VISATT task: the larger the CNV, the lower the rate of misses targets.

**Conclusion**: The older subjects exert covert compensation strategies which are used for improving performance in both subtasks, namely better tracking just before a critical phase and better recognition of cues and subsequent targets!
Experiment 1

P3 – CONTROLLED PROCESSING OF (NON-)TARGET STIMULI

Hahn et al., 2011

Karthaus, Wild-Wall, Falkenstein; Ageing and Safe Mobility, Human Factors, 27.-28.11.2014, BASl, Bergisch Gladbach
Experiment 1

**P3 – CONTROLLED PROCESSING OF (NON-)TARGET STIMULI**

![Graph showing P3 waves for Young and Older Groups]

- **Young Group**
- **Older Group**

Amplitude [μV] vs. Time [ms]

- **relevant targets**
- **relevant non-targets**
- **irrelevant targets**
- **irrelevant non-targets**

Lack of differentiating between relevant and irrelevant stimuli

*Hahn et al., 2011*

Karthaus, Wild-Wall, Falkenstein; Ageing and Safe Mobility, Human Factors, 27.-28.11.2014, BAS, Bergisch Gladbach
MULTIPLE DRIVING TASK IN A DRIVING SIMULATOR

**Compensatory Tracking (T):**
Keeping the lane while following a car

**VISATT (V):**
same as Exp. 1

**Braking Task (B):**
Pressing the brake pedal as fast as possible as response to the flashing brake light of the car in front

**Participants:**
20 young (25-31 years, Ø 27.3 years, 10 male)
20 older (60-69 years, Ø 63.9 years, 10 male)

>>> Multiple task types:
TV – TB – TVB
RESULTS

• No age-related difference in overall tracking performance
• Best tracking performance in TB (both groups)
• Only in the 10ms TVB-condition the older group responded slower and omitted more brake lights than the young

Hahn et al., 2013
SUMMARY & DISCUSSION

1. Differentiation between relevant and irrelevant stimuli seems to be more difficult for older than for young people.

2. In situations where distractors occur almost simultaneously with critical events, necessary actions to those events can be impaired in terms of slower responses and/or more errors.

Possible implications for future traffic environment and IVIS design:

- Avoidance of irrelevant stimuli, especially in complex traffic situations like crossroads.
- Emitting warning signals to avoid irrelevant actions like listening to the radio or talk to passengers.
Thank you for your attention!

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