

# Validation of a visual attention test to detect driver fatigue

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## 1 Background



**Driver fatigue** belongs to the major causes of traffic accidents [1].

Fatigue limits:

- Ability to drive [2]
- Visual attention performance, especially in the left visual field [3]



**Lack of objective, rapid, non-invasive measurement techniques in police traffic controls.**



This study is a first step to investigate whether a previous developed ecologically valid test for screening visual attention could be a possibility to detect fatigue to a certain degree.

**Hypothesis:** The detectability of the signal and the reaction time to the signal is better in the right visual field compared to the left visual field when participants are tired.

## 2 Method Overview

### Visual attention test (Menozzi et al., 2012):

- Computerized test (duration: 4 min)
- 6-digit number appearing on background movie showing a car drive either in the left, central, or right visual field for 300ms (fig. 1)
- Task: report whether number includes the digit «3»
- Measured variables: detectability  $d'$ , reaction time (RT)



Fig. 1: Snapshot of the test

### To produce fatigue:

- 30-minute drive on a driving simulator (fig. 2)
- Task: follow a front car at a constant distance on a monotonous highway



Fig. 2: Driving Simulator

### Control measurements to test if fatigue increases:

- Karolinska Sleepiness Scale (KSS), and Instantaneous Self Assessment (ISA) questionnaire every 5 minutes during the drive
- Recording of the standard deviation (SD) of lateral position during the driving task

**Participants:** 21 (13 m, 7 f); valid driving license; Age: 19 y to 43 y ( $M=27.75$  y,  $SD=4.96$  y)

- Randomly divided into two groups to investigate whether the time at which the attention test is performed after the 30-minute drive matters

### Overview of the test procedure:

SSQ: simulator sickness questionnaire  
PQ: presence questionnaire

- |                                  |                                  |
|----------------------------------|----------------------------------|
| Group I                          |                                  |
| 1. ISA, KSS                      | 5. Visual attention test (4 min) |
| 2. Visual attention test (4 min) | 6. ISA, KSS                      |
| 3. ISA, KSS                      | 7. SSQ, PQ                       |
| 4. Driving simulator (30 min)    |                                  |
| a. ISA, KSS (every 5 min)        |                                  |
| Group II                         |                                  |
| 5. SSQ, PQ                       | 5. Visual attention test (4 min) |
| 6. ISA, KSS                      | 8. ISA, KSS                      |

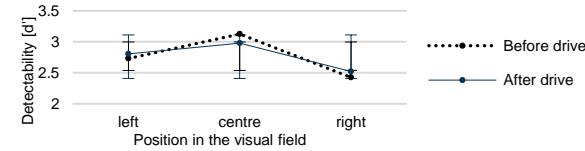
## 3 Results

- KSS score** increased significantly over the 30-minute drive [Friedman test:  $\chi^2(5) = 60.786$ ,  $p < 0.01$ ,  $n=21$ ]
- SD of lateral position** varied significantly with driving time [One-way repeated ANOVA with time-on-task separated into six 5-min periods,  $F(5,90)=3.696$ ,  $p<0.01$ ,  $\eta^2=0.170$ ]
- Visual attention test:**

### Three-way ANOVA (2x3x2)

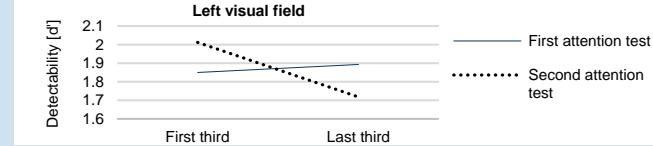
	Time (before/after drive)	Location of presented number (left/central/right)	Group (I/II)
$d'$	$p=0.617$	$p<0.01^{**}$	$p=0.744$
RT	$p=0.355$	$p<0.01^{**}$	$p=0.514$

Post-hoc analysis (Bonferroni-corrected pairwise comparisons: left/central/right: No significant difference between the left and right visual field ( $p=0.073$ )).



### Separate analysis of first and last-third of the attention test:

- 68% of participants showed a lower  $d'$  ( $p > 0.05$ ) in second attention test compared to first test:



## 4 Discussion & Conclusion

Already a 30-minute drive is a fatigue factor

There was no effect of fatigue on the attentional performance.

- Possible reasons:
  - Too low sensitivity of test to detect small changes in fatigue
  - Young average age: the psycho-motor and cognitive performance of young people is high enough to compensate small effects of fatigue.

Results indicate that the effect of fatigue might be seen in the last third time section of the attention test

- Possible reason:
  - Background is the most complex in the last third.  
→ Require high cognitive capacity, but reduced by fatigue, to maintain performance

## References

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