Truck drivers’ turning information concept – a psychological approach

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Agenda

- Truck driving – the visual field
- Turning information concept
- Human factors’ approach
- Where to place visual information?
- What about colors?
- How to avoid disturbance?
- Conclusions
Truck driving – the visual field

Driver’s head and gaze turns in the direction of driving!
Turning information concept

→ No accident prone situation
Turning information concept

→ Driving straight ahead, blind spot detection
→ Driving straight ahead, preparing turning, (direction indicator maybe activated)
→ Begin turning, direction indicator **maybe** activated,
→ gaze perhaps into mirror’s direction
Human factors’ approach

- **Drivers’ task**
  - steer and control with available information
  - primarily visual (ANDERSEN, 2011)
  - many decisions in short time span

- **Humans make decisions very fast under uncertainty**
  - by available information
  - by representative information (memory involvement)

(TVERSKY & KAHNEMAN, 1974)
**Human factors’ approach**

1. Support drivers with information!
2. Make perception possible!
4. Notice recommendations of design! (e.g. EN ISO 9241 [110])
5. Take situational aspects into account! (POWELLEIT ET AL., 2015)
   (e.g. accident prone situations)
What do we need?

We need a recognizable and interference-free information concept!
Where to place visual information?

➢ Spatial resolution depends on the optical angle! *(GOLDSTEIN, 1997)*

https://www.psychologie.uni-heidelberg.de/ae/lehre/wcl/w/w3_visuelles_system/w321_staebechen_und_zaeufchen.htm
Where to place visual information?

- Experimental study with participants $N=30$
  (age between 20 and 45 years, $M=30.53; SD=7.57$):
- Reaction to peripheral visual stimuli (LED)
- Duration 50 ms, different time intervals
- With/without driving task

HOFFMANN et al. (2013)
Where to place visual information?

- The driving task is important for reaction times
  - \( F(1,29) = 92.16, p < .001 \)

- Reactions to visual stimuli in 20° are significant faster than reactions to stimuli of 60°
  - \( F(1,29) = 92.16, p < .001 \)
Where to place visual information?

**Explanation:**
- More easily to recognize stimuli at 20° in comparison to 60°
- Marginal effect sizes!
- Drivers are able to notice visual stimuli even at 60° without moving their gaze

**With driving task:**
- Significantly more misses of stimuli from 60° than from 20°
- $z=-5.21, p<.001$

**Laboratory condition:**
- Participants know that stimuli will occur at defined positions.

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What about colors?

- Color-effect only for small stimuli (1° visual angle)  
  (WERNEKE & VOLLRATH, 2011)

- Recognition of colors in periphery: lower spatial resolution  
  (GEGENFURTHNER & HANSEN, 2006)

- Enhancement of size and intensity of stimuli → enhance the possibility of perception

<table>
<thead>
<tr>
<th>color</th>
<th>Visual angle nasal</th>
<th>Visual angle temporal</th>
<th>Visual angle total</th>
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</tr>
<tr>
<td>green</td>
<td>10°</td>
<td>50°</td>
<td>60°</td>
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</tbody>
</table>

BIRBAUMER & SCHMIDT (1999); WOODSON & CONOVER (1964)
How to avoid disturbance?

- No use of warnings!
  - A warning creates maximum attentional focus
    (e.g. visual + acoustic + tactile) (WICKENS, 2002)
  - This can lead to distraction!

- Use of information!
  - Giving a hint to a danger without disturbance is possible
  - Avoidance of startle responses
How to avoid disturbance?

- Well-balanced flashing
  - Enhancement: higher urgency
  - more disturbance possible (BALDWIN & LEWIS, 2013)

- Survey \(N=36\) (FÄRBER, 2003)
  - Camera-Monitor-Systems (monitor in approx. 30°)
  - approx. 50\% of participants prefer an bicycle icon inside the monitor when a bicycle appears in the blind spot
  - approx. 14\% dislike it

- 30° (around fixation) is most important for vehicle control!
  (LACHENMAYR, 2006)
Turning information concept

The balance between recognizable and interference-free is the key!

- You can achieve it!
  - ...using the periphery
  - ...using human’s gaze movement

- Display blind spot information!
Turning information concept

- Display blind-spot information!
  - Stamp out the blind spot!
  - Familiar for drivers (car experience)
  - Drivers expect backward information next to mirrors
  - Benefit of 23% regarding injury crashes (CICCHINO, 2017)
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Conclusions

- Not disturbing (robustness in case of false positives)!
- Well informing (in use case)!
  - Perception increases when gaze turned!
- Information location (e.g. at A-pillar) equivalent with hazard location!
  - Information is at the right place at the right time!
- Use of mirrors is encouraged!
- Overall: Good support in complex situations!
Thank you for your attention!

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References

- ANDERSEN, G. J. (2011): Sensory and perceptual factors in the design of driving simulation displays. In: D. L. FISHER; M. RIZZO; J. K. CAIRD; J. D. LEE (Eds.): Handbook of Driving Simulation for Engineering, Medicine, and Psychology (pp. 8-1-8-11). Boca Raton, FL: CRC Press
- EN ISO 9241 [110]
References