A Comparison of Head-Up and Head-Down Displays for Different Types of Information: Driving in an Urban Setting

**Attention control**
General increase of attention or non-specific reference to risky situations e.g. warning tone

**Situational information**
Specific warning with indication of type/location e.g. lane change warning

**Action directives/request**
Concrete presentation of the required reaction e.g. demand to brake, navigation instructions

**Conditional information**
Representation of the vehicle state e.g. display of availability or indication

**Detailed information**
Numerical values or text content e.g. speedometer

**Urban Areas and Scenarios**
- higher complexity
- obstructions of road signs and other cars
- multiple road users
- weaker road users
- additional stimuli

**Method**
- Training session at beginning
- 2 blocks driving 20 min each
- One block with Head-Up and one with Head-Down Display
- All three warning types where displayed respectively on each component per trial

**Participants**
- 32 volunteers
- 7 female; 25 male
- Age: 25.8 years (± 2.9)
- Driving experience ≥ 5 years
- No vision impairments
- 21 with simulator experience

**Reaction time**

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PST = 634</td>
<td>PST = 735</td>
<td>PST = 432</td>
</tr>
<tr>
<td>831</td>
<td>1177</td>
<td>1110</td>
</tr>
<tr>
<td>1278</td>
<td></td>
<td></td>
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</tbody>
</table>

**SD of speed over allowed speed in [km/h]**

<table>
<thead>
<tr>
<th>Speed</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
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</thead>
<tbody>
<tr>
<td>4.5</td>
<td>0.34</td>
<td>0.35</td>
<td>0.34</td>
</tr>
<tr>
<td>4.7</td>
<td>0.34</td>
<td>0.35</td>
<td>0.34</td>
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</tbody>
</table>

**SD of the distance to lane center in [m]**

<table>
<thead>
<tr>
<th>Distance to lane center</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.34</td>
<td>0.35</td>
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