Driver distraction without presence of secondary tasks: Inattention, cognitive overload and factors outside the vehicle – an overview.

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Abstract
Distraction is induced through a variety of sources that can be present both inside and outside the vehicle, and may involve a secondary task (e.g. mobile phone use). This study aims to provide an overview of the effects of distraction induced without the presence of a secondary task, categorized in two different groups: 1) driving under an improper state of mind, which includes inattention and distractions through cognitive overload and 2) factors outside the vehicle, comprising static objects or advertising signs, visual impairing glare by sun or other vehicle lights and observing people or situations outside the vehicle. For inattention and distraction through cognitive overload, 11 high quality studies were reviewed and it was found that inattention and distraction through cognitive overload had several categories. For distraction factors outside the vehicle, 12 high quality studies were reviewed. These studies raise mostly negative impacts on road safety, with all statistically significant effects being detrimental both accident numbers and accident injury severity.

Objectives
i. This study aims to examine the effects of distraction caused by:
   a. Inattention and cognitive overload
   b. Factors outside the vehicle (static objects or advertising signs, sun or other vehicle’s lights)
   - The analysis was carried out within the SafetyCube project, which aims to identify and quantify the effects of risk factors and measures that related to behaviour, infrastructure or vehicle, and integrate the results in an innovative road safety Decision Support System (DSS).

Methodology
- Studies were selected and analyzed in a set taxonomy – distraction had several categories.
- Inattention - cognitive overload and outside vehicle factors (static objects or advertising signs, sun glare or vehicle lights and watching people or situations) were explicit taxonomy topics.
- Studies published in scientific journals were prioritized over conferences over grey literature.
- Specific criteria were set and followed:
  i. Study year: 1990 or newer
  ii. Good overall quality
  iii. Verification and transferability of results
  iv. Existing meta-analyses prioritized at all times.
- Analysis in studies in terms of design, methods and limitations.
- Aiming for synthesis of findings & conducting meta-analysis when feasible.
- If not, vote count analysis is conducted, or qualitative (review type) analysis otherwise.

Study Elements analyzed
- Road system element (Road User, Infrastructure, Vehicle) and level of taxonomy so that users of the DSS will find information they are interested in.
- Basic information of the study (title, author, year, source, origin, abstract).
- Road user group examined.
- Study design / Limitations.
- Measures of exposure to the risk factor – Measures of outcome (e.g. number of injury crashes).
- Type of effects (quantified exposure – to a risk factor or a measure – and road safety outcome).
- Statistical effects (including corresponding measures e.g. confidence intervals).
- Summary of information relevant to SafetyCube (may be different from original abstract).

Overview of Studies analyzed
- 20 studies on driver distraction related risk factors have been coded.
- 81 effects for the examined risk factors.
- 2 synopses have been authored for inclusion in the DSS.
- Many different outcomes were observed from located studies.
- Lack of relevant meta-analyses was observed in the literature.
- The topics appear somewhat under-researched.
- Instances of lack of consistency between results.

Results – Inattention & Cognitive Overload – Vote Count Analysis

<table>
<thead>
<tr>
<th>Outcome definition</th>
<th>Tested in number of studies</th>
<th>Result (% of studies)</th>
<th>Result (% of effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash count</td>
<td>2</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Injury severity</td>
<td>2</td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Eye blink frequency</td>
<td>1</td>
<td>100.0%</td>
<td>83.3%</td>
</tr>
<tr>
<td>Blink duration</td>
<td>1</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Perception of distraction/driving behavior change</td>
<td>2</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Attention to environment</td>
<td>1</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Outward view – Central Area</td>
<td>1</td>
<td>100.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Instrument inspection</td>
<td>1</td>
<td>100.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Mirror inspection</td>
<td>1</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Glances at traffic lights</td>
<td>1</td>
<td>100.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Times ignoring traffic lights</td>
<td>1</td>
<td>100.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Braking performance</td>
<td>1</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Perception of workload</td>
<td>1</td>
<td>100.0%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Perception of safety reduction</td>
<td>1</td>
<td>100.0%</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

Results – Outside vehicle factors – Qualitative Analysis

- Studies would conduct one of the following:
  i. Multivariate statistical analysis models
  ii. Descriptive statistical analysis and absolute/relevant difference or proportion comparisons
  iii. Crash counts are elevated both by sun glare and advertising signs, and appear increased in one case from watching outside persons and situations and reduced in another
  iv. Injury severity levels were elevated while watching outside persons and situations.

Conclusions
- Identification and evaluation of certain distraction related risk factors was conducted, resulting in their assessment regarding road safety.
- Both inattention and cognitive overload and outside vehicle factors had a mostly detrimental impact, by:
  i. Increasing accident numbers and accident injury severity
  ii. Reducing the performance of several behavioral variables such as perception or braking performance.
- Lack of meta-analyses in these topics is a major gap of knowledge in driver distraction.

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