

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, vision-impairing glare by sun or other vehicles' lights and observing people or situations outside the vehicle. For inattention and distraction through cognitive overload, 8 high quality studies were reviewed and it was found that inattention has a mostly detrimental effect on road safety. The specific impacts of these distractions vary, but they are negative and show that driver behavioral variables such as perception and braking performance are affected. There are some positive results that show reduced injury severity or increased perception, mainly due to overcompensation effects. For distraction factors outside the vehicle, 12 high quality studies were reviewed. These factors create mostly negative impacts on road safety, with all statistically significant effects being detrimental. Both accident numbers and various behavioral variables such as lateral control and speeding are affected. There some effects that were not statistically significant. Based on the sample of countries of the reviewed studies, the results appear to be generally transferable with caution, especially for industrialized countries.

Objectives

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

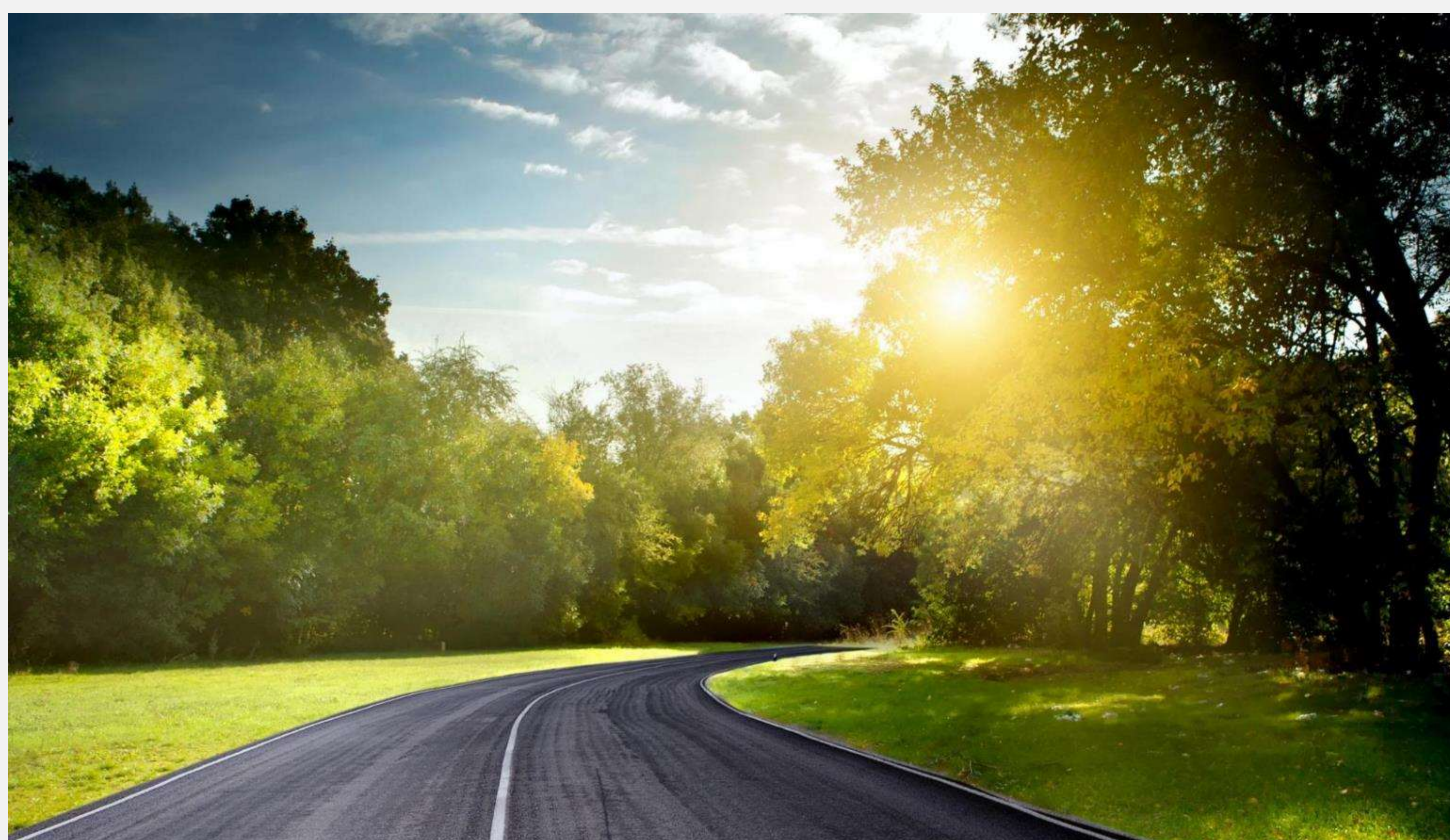
Methodology

- 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:
 - Study year: 1990 or newer
 - Good overall quality
 - Verification and transferability of results
 - Existing meta-analyses prioritized at all times.
- Analysis** of 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)

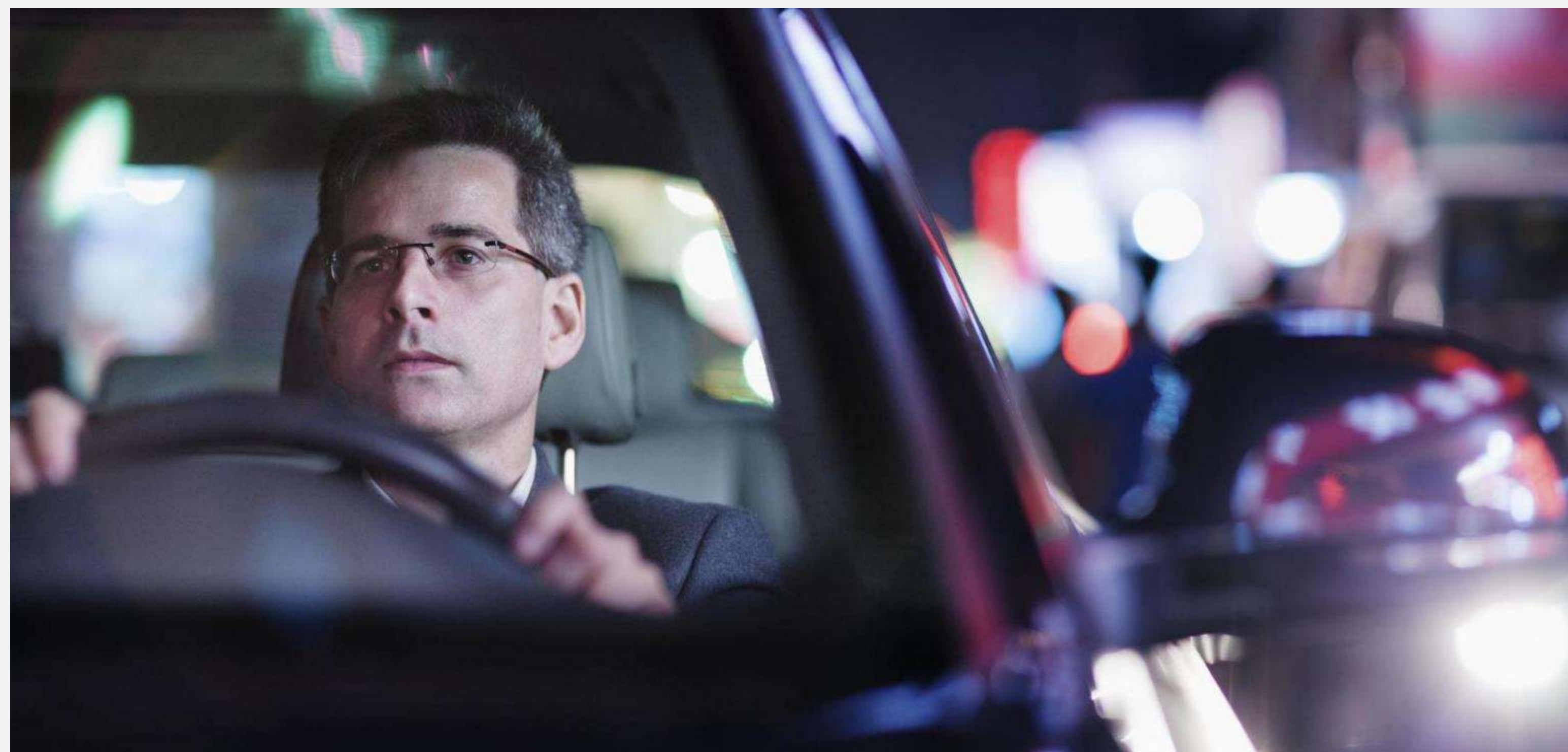


Overview of Studies analyzed

- 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 (3+2 distraction factors were merged)
- 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

Outcome definition	Tested in number of studies	Result (% of studies)			Result (% of effects)		
		↑	-	↓	↑	-	↓
Crash count	2	-	100.0%	-	-	100.0%	-
Injury severity	2	50.0%	-	50.0%	50.0%	25.0%	25.0%
Eye blink frequency	1	100.0%	-	-	83.3%	-	16.7%
Blink duration	1	-	100.0%	-	50.0%	-	50.0%
Perception of distraction/driving behavior change	2	100.0%	-	-	100.0%	-	-
Attention to environment	1	100.0%	-	-	100.0%	-	-
Outward view – Central Area	1	-	100.0%	-	-	50.0%	50.0%
Outward view – Peripheral Area	1	100.0%	-	-	50.0%	50.0%	-
Instrument inspection	1	100.0%	-	-	50.0%	50.0%	-
Mirror inspection	1	100.0%	-	-	100.0%	-	-
Glances at traffic lights	1	100.0%	-	-	50.0%	50.0%	-
Times ignoring traffic lights	1	100.0%	-	-	50.0%	50.0%	-
Braking performance	1	100.0%	-	-	100.0%	-	-
Perception of workload	1	100.0%	-	-	66.7%	33.3%	-
Perception of safety reduction	1	100.0%	-	-	66.7%	33.3%	-



Results – Outside vehicle factors – Qualitative Analysis

- Studies would conduct one of the following:
 - multivariate statistical analysis models** (ex. ordered logit or mixed effects logistic regression model)
 - forms of **analyses of variance (ANOVA)** statistical models
 - descriptive statistical analysis** and absolute/relevant difference or proportion comparisons
- 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
- Injury severity levels were **elevated** while watching outside persons and situations
- Advertising and road signs resulted in **increased**:
 - drifting from lane instances,
 - recklessly crossing dangerous intersections,
 - time to change lanes or spent out of lane,
 - braking distance and reaction time,
 - fixations and other relevant variables
- Glare from vehicle lights resulted in **increased** detection distance and more missed targets; Speeding variations were due to different road widths and not the effect of sun glare
- Limitations can be found as well:
 - Study designs: either use past data (imperfect reporting or biases) or simulators
 - Sometimes there is a dependence on self-reporting
 - Difficulties in capturing the exact effect of each distraction factor
 - Lack of studies examining distraction of other road users except drivers

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:
 - increasing accident numbers and accident injury severity and
 - 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

Acknowledgement

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