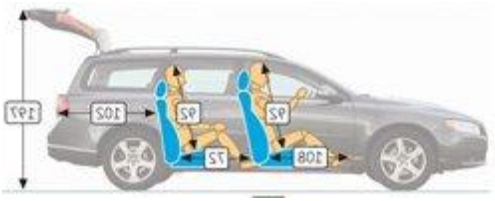
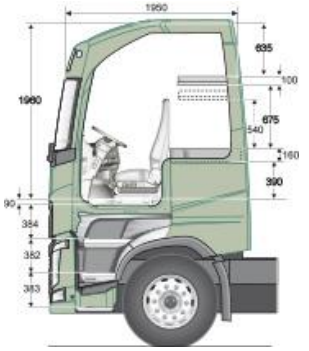
Virtual eye height and display height influence visual distraction measures in simulated driving conditions

Claudia Wege

Advanced Technology & Research

Volvo Group Trucks Technology (GTT)

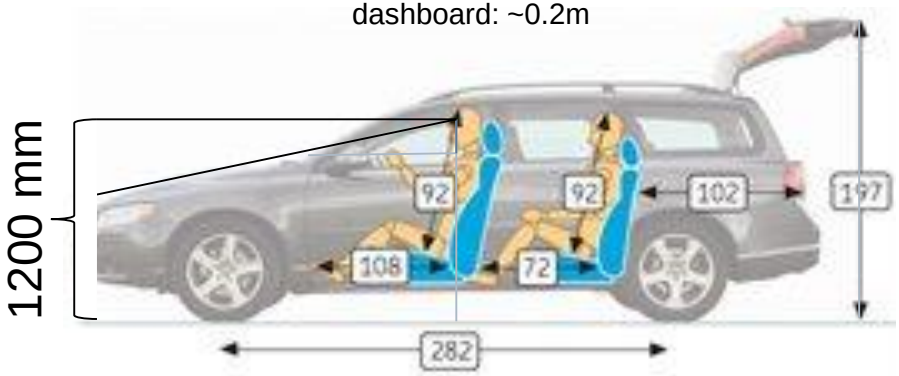




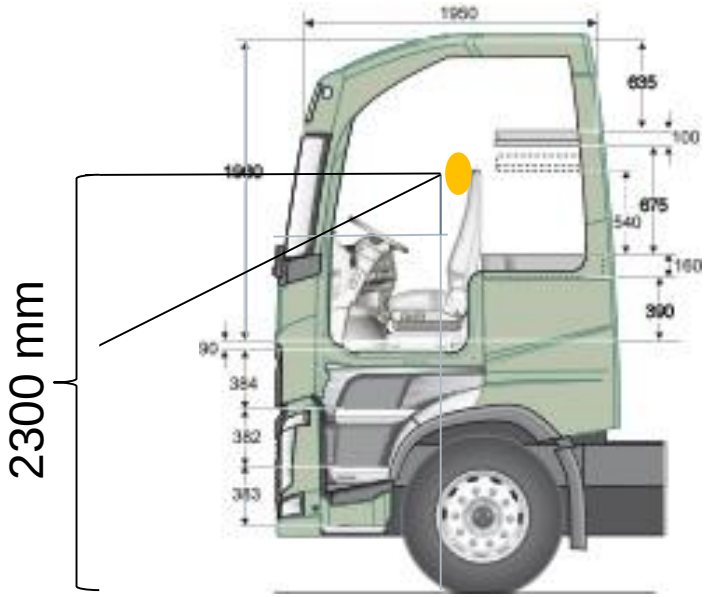
Safe Interaction Connectivity and State (SICS)
Seamless, Efficient and Enjoyable inteRaction (SEER)
Funded by Vinnova, Sweden's Innovation Agency

Can (simulator) road view and display position affect glance behaviour?

Eye over dashboard: ~0.2m



Eye over dashboard: ~0.4m



Background

- Display design
  - Glance behaviour towards in-vehicle visual displays is not only a result of the **design of the display** itself, but also influenced by other, **contextual factors**.
- Guildelines
  - Research ongoing on how to reduce visual distraction from in-vehicle interfaces. **Guidelines** prescribing **acceptable glance times etc.**
- Truck vs car
  - Experience suggest that truck drivers have better overview of the forward roadway – will this affect glance behaviour?

JAMA

(Japan Automobile Manufacturers Association)

Guideline for In-vehicle Display Systems — Versio

1. Basic Concepts

Traffic congestion information and navigation are among the functions of systems the functions which contribute to the enhancement of traffic safety traffic flow, and preservation of the environment. However, for drivers, t information from the display systems installed inside vehicles constitut addition to their driving work. Accordingly drivers have been found to sh refrain from scanning and operating their display systems when the driving as compared to when the driving workload is light.

This sparing of scanning and operating the display systems is believed behavior inherent in human beings. Therefore, it is important to prescril information to be displayed, method of display system operation, and lo systems in order to make use of the beneficial functions of in-vehicle displ at the same time allowing the defensive behaviors of drivers. For this purp four principles are established, according to which the specific requireme display systems are stipulated in section 3 onward of this Guideline:

(1) Preferably, a display system is so designed that its adverse effect o be kept to a minimum.

(2) Preferably, a display system is installed in such an in-vehicle positi operation and the visibility of forward field will not be obstructed.

(3) Preferably, the types of information to be provided by a display sy the driver's attention will not be distracted from driving; for exam types of information need to be avoided.

(4) Preferably, a display system can be operated by the driver without a his or her driving work.

2. Scope

(1) This Guideline applies to display systems (whether factory-installe dealer who has been designated by the vehicle manufacturer) thr vehicles but not including motorcycles and are located at a positio driver.

(2) A "display system" in this Guideline means a system capable of dis letters, numbers and/or images that have been stored in memories received through broadcasting or telecommunication.

1

Statement of Principles, Criteria a Verification Procedures on Drive Interactions with Advanced In-Vehicle Information and Communication Systems

Including Updated Sections

Driver Focus-Telematics Working Gro

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

Docket No. NHTSA-2010-0053

Visual-Manual NHTSA Driver Distraction Guidelines

For In-Vehicle Electronic Devices

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).

ACTION: Notice of Federal guidelines.

SUMMARY: The National Highway Traffic Safety Administration (NHTSA) is concerned about the effects of distraction on motor vehicle safety due to drivers' use of electronic devices. Consequently, NHTSA is issuing nonbinding, voluntary Driver Distraction Guidelines (NHTSA Guidelines) to promote safety by discouraging the introduction of excessively distracting devices in vehicles.

This notice announces the issuance of the final version of the first phase of the NHTSA Guidelines. This first phase applies to original equipment (OE) in-vehicle electronic devices used by the driver to perform secondary tasks (communications, entertainment, information gathering, navigation tasks, etc. are considered secondary tasks) through visual-manual means (i.e., the driver looks at a device, manipulates a device-related control with his or her hand, and/or watches for visual feedback).

The NHTSA Guidelines list certain secondary tasks believed by the agency to interfere inherently with a driver's ability to safely control the vehicle. The NHTSA Guidelines recommend that in-vehicle devices be designed so that they cannot be used by the driver to

Hypotheses

- **H1.** Truck road view (eye point high above road, low dashboard) leads to longer glances (in mean) and more long glances (>2s) towards a visual display than car road view (eye point low above road, high dashboard)
- **H2.** Lower display position leads to shorter glances (in mean) and fewer long glances (>2s) towards a visual display compared to a high display position.
- **H3.** There are interaction effects between type of task and view and as well as between type of task and display position.

Experiment

- 25 participants, half had C/CE truck license
- Medium sized fixed-base simulator (real truck dashboard/controls and seat, 30 deg FOV)
- Eye glances measured using Dikablis head mounted eye tracker
- Mixed-factorial design
  - IV: 2 views (truck/car) x 2 display positions (high/low) x 3 tasks (easy/medium/difficult)
  - DV: Glance length (>2s), Glance frequency, MGD, TGT, Task completion time, Subjective driving performance assessment after each condition, Interviews

Views

Car view
1.2 m above ground

Truck view
2.3 m above ground

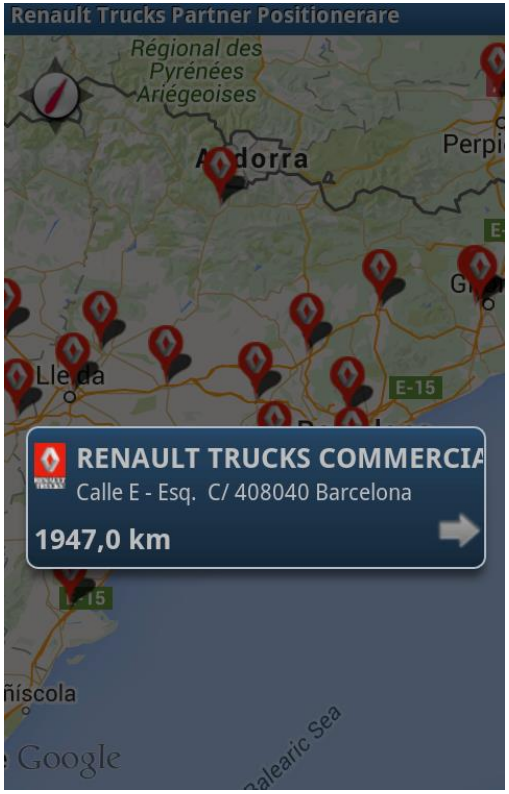
20 degrees down

45 degrees down

Tasks

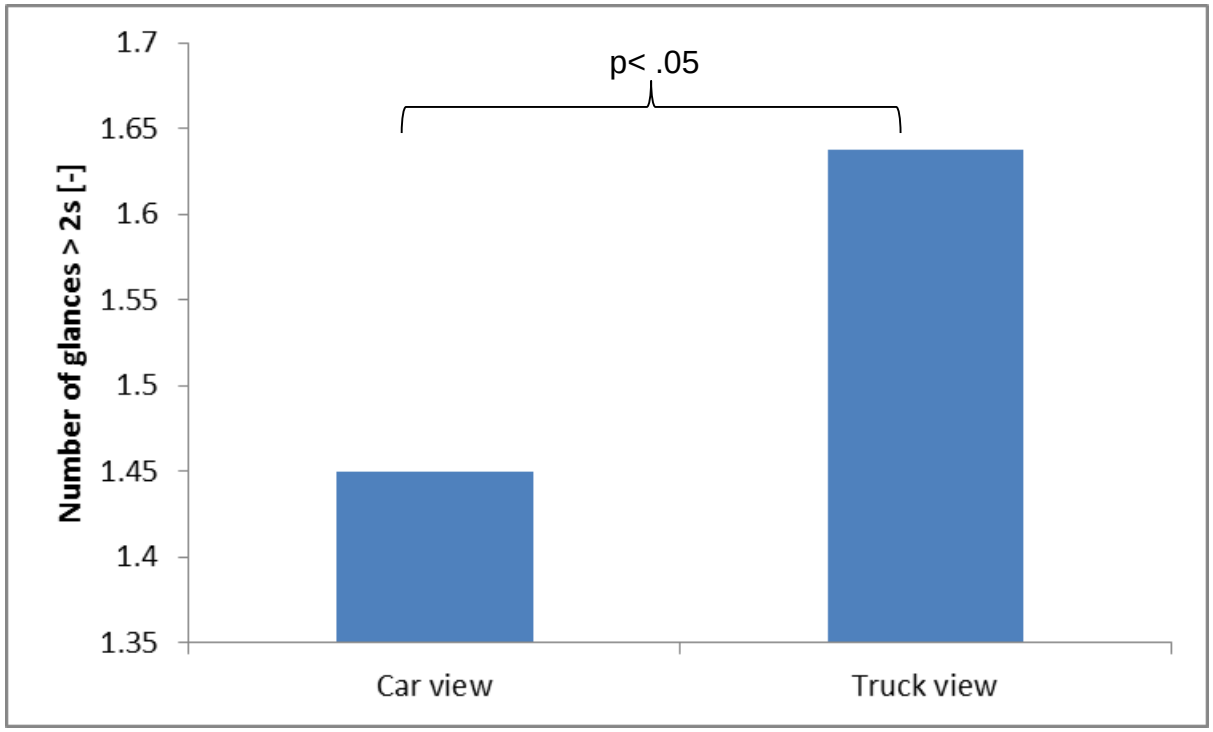
Tune radio
(easy)

Set alarm
(medium)



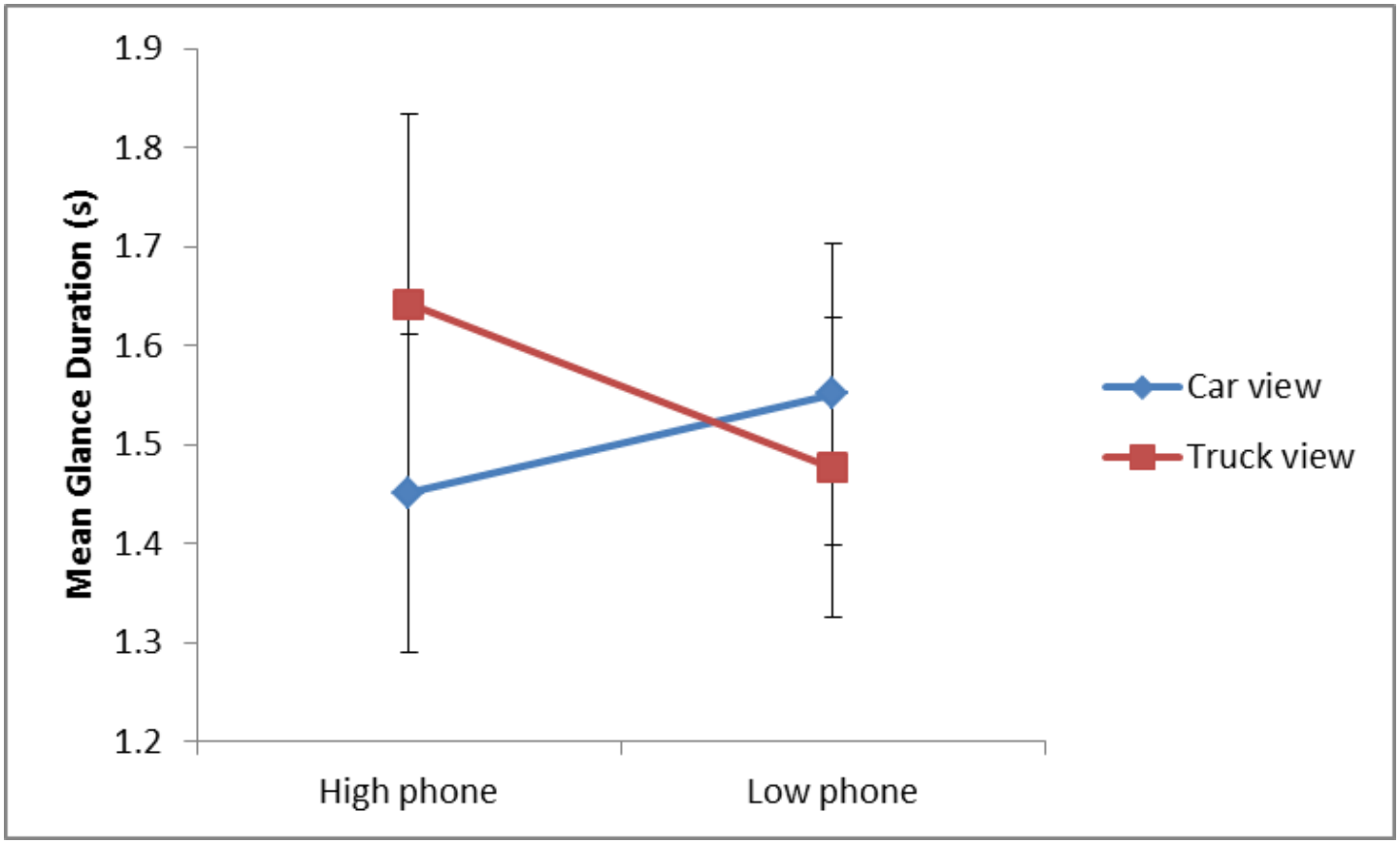
Find truck dealer
(hard)

Effect of view on long glances (>2s)

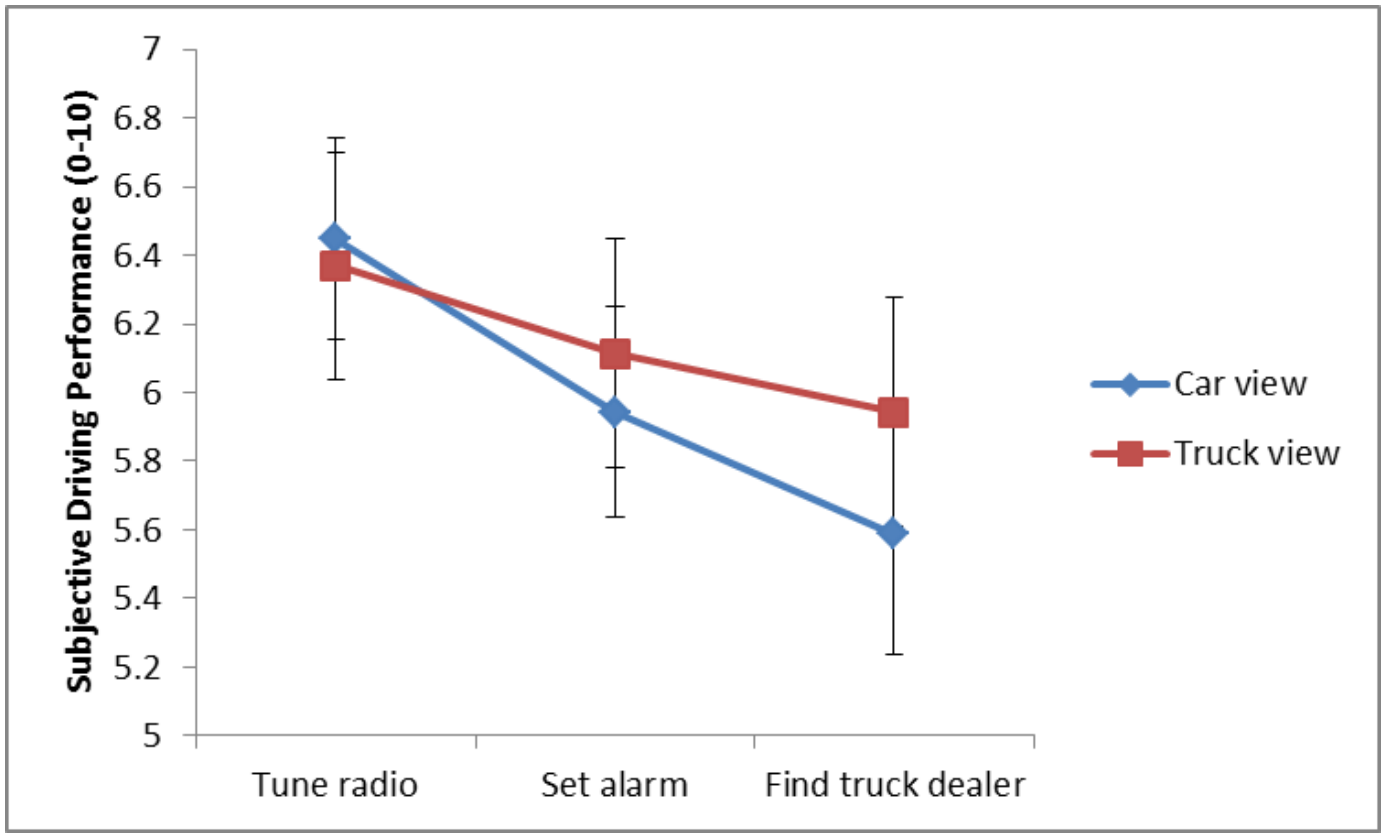


(similar trends for other measures like TGT and MGD, no other significant differences however)

Interaction effect, display position x view on Mean Glance Duration



Interaction effect, task difficulty x view on Subjective Driving Performance



Other effects

- The high phone position rendered higher Subjective Driving Performance than the low one (M = 6.20 vs. M = 5.94)
- For an easy task (tune radio), phone position did not affect task completion time, while it did for difficult tasks (high phone position => shorter task completion time)
- Effect on experience (truck vs car drivers)

Implications

⇒Implications for the specification of guidelines which postulate glance measurement **pass/fail criteria** for in-vehicle interfaces.

⇒For academia & industry: a strict definition of the **simulator scene** and setup needs to be defined for the criteria to be valid and comparable

⇒For 3rd party developers (e.g. Google, Android Auto, Car play): **valid testing.** Case for “pairing”.

⇒Should there be **individual criteria** for different vehicle classes?

⇒How do the results relate to **safety**? E.g. truck drivers may look longer and down more often than car drivers but - since they have a “better view“ – does that make the situation less safe?

Thank you!

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Pontus Larsson, Johan Engström, Claudia Wege

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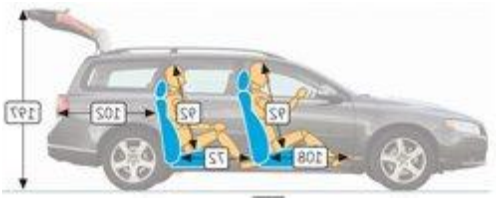
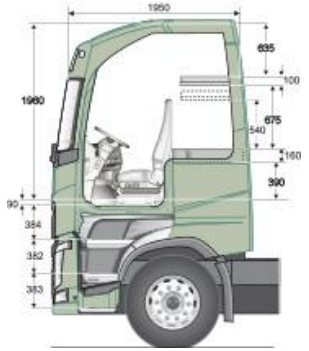


Full paper in eProceedings



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