COMPARISON OF STATIC AND DRIVING SIMULATOR VENUES FOR THE TACTILE DETECTION RESPONSE TASK

Johan Engström, Pontus Larsson and Christian Larsson

ADVANCED TECHNOLOGY AND RESEARCH, VOLVO GROUP TRUCKS TECHNOLOGY, GOTHENBURG, SWEDEN

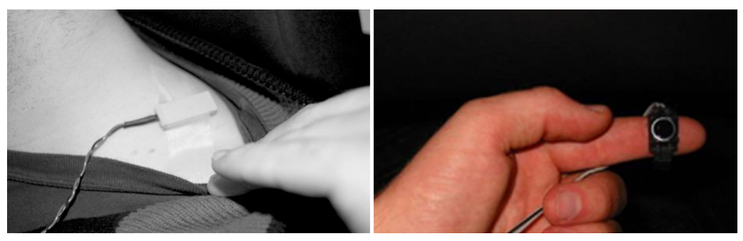
INTRODUCTION

The Detection Response Task (DRT)

- Previously known as the Peripheral Detection Task (PDT)
- Has become a popular method for measuring the effects of driving and secondary task demand on driver attention, in particular in the context of driver-vehicle interface evaluation
- Measures such effects in terms of the performance on a simple detection-response task where the subject presses a button in response to stimuli presented at an interval of 3-5 seconds.
- Subject to ISO standardization (ISO, 2012)
- Considered by NHTSA for inclusion in the Phase 3 Drive Distraction Guidelines for auditory- vocal human-machine interfaces

The Tactile Detection Response Task (TDRT)

- Specific version of the DRT where the stimulus consists of a vibration issued by a small vibrator (tactor) attached to the body.
- First tested in an on-road study by Engström et al. (2005)
- The TDRT has since then been further developed and demonstrated sensitive to both driving and secondary task load (Merat and Jamson, 2008; Mattes, Föhl and Schindhelm, 2008; Diels, 2011; see Engström, 2010, for a general review)
- Potential advantage: Eliminates effect of gaze eccentricity – "purer" measure of cognitive load



DRT venues (ISO, 2012)

- On-road
- Driving simulator
- Semi-static: Includes surrogate driving task
- Static: No driving or surrogate driving task

Open issue: To what extent do measurements obtained in the static venue generalize to the more ecologically valid driving simulator and on-road venues?

Objectives

- Compare effects of different types of secondary task demand on TDRT performance in static and driving simulator venues. Do the effect of venue interact with the effect of secondary task demand?
- Investigate to what extent the two venues yield similar sensitivity to systematic manipulations of cognitive and visual-manual load

Part of a set of international coordinated studies, conducted under ISO TC22/SC13/WG8

SECONDARY TASKS

- *n-back* task (Mehler, Reimer and Dusek, 2011)
  - Repeat numbers in a sequence of numbers read up by a recorded voice
  - 0-back: Repeat the number just heard
  - 1-back: Repeat the number one step back in the sequence
- *Surrogate Reference Task* (SuRT; ISO, 2010)
  - Search for a target circle differing in size compared to a set of surrounding distractor circles
  - Mark the location of the target circle by moving the gray area using a keypad
  - Self-paced
- Ask Siri pre-defined questions to the Siri function featured on the iPhone 4S
- All secondary tasks performed for one minute and repeated twice (order counterbalanced)

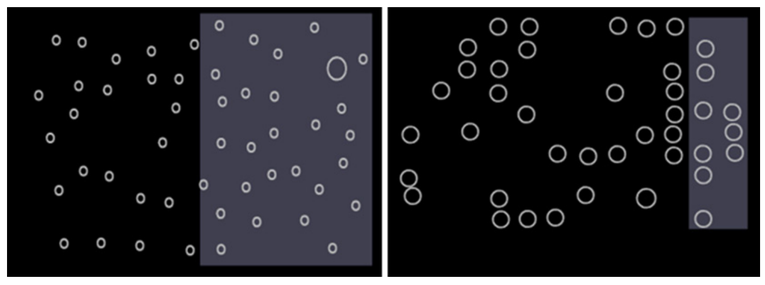
METHOD

Participants

- 16 male participants
- 29-51 years (mean 36.8, SD 6.6)
- All participants held a truck driver's license

Venues

- *Driving simulator* venue: Fixed-base truck simulator at Volvo Advanced Technology and Research (ATR)
- *Static venue*: Participants positioned in the driver's seat in the truck cabin and performed the secondary tasks without driving



SuRT Easy

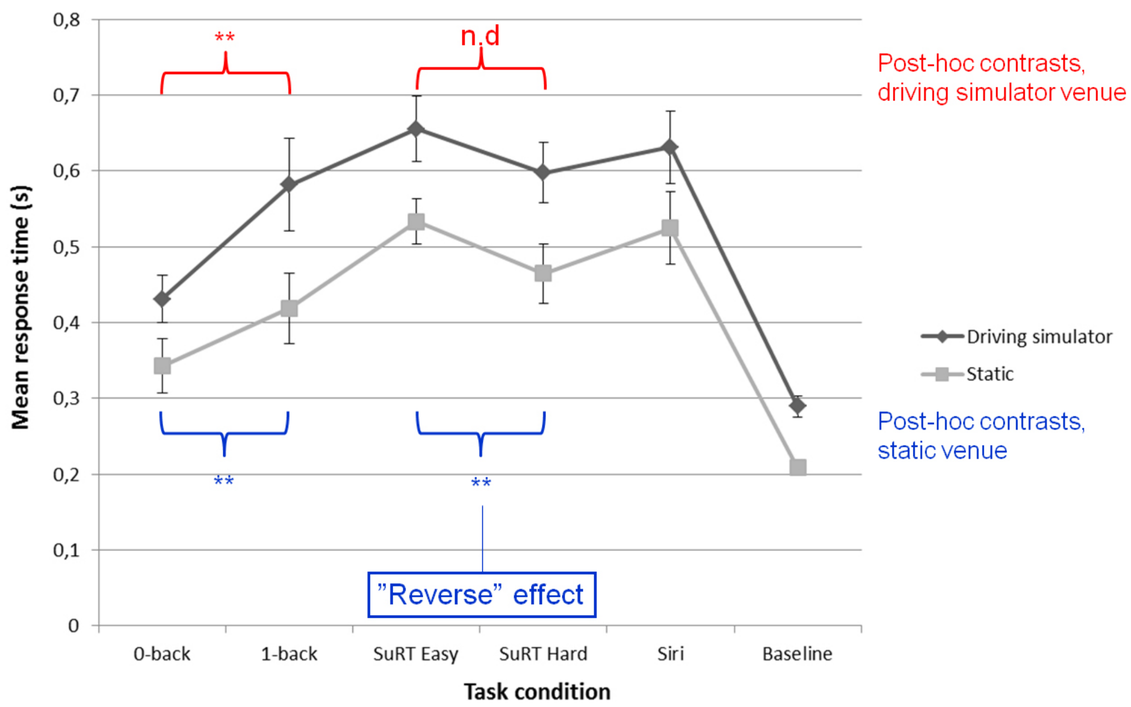
SuRT Hard

Simulated driving task

- Free driving on a motorway with moderate curvature.
- Some ambient traffic present but did not directly interact with the participant's vehicle
- Posted speed was 90 km/h and higher speeds were prevented by means of a speed limiter

RESULTS

- Significant main effect of Task ($F(2.9, 43.2)=43.6$, $p<.001$)
- Significant main effect of Venue ($F(1, 15)=24.8$, $p<.001$)
- No interaction between Task and Venue
- 1-back yielded significantly longer RTs than 0-back in both venues
- Significantly longer RT for SuRT Easy in static condition ("reverse" effect)
- Subjects still rated SuRT Hard as more demanding



CONCLUSIONS

- The TDRT is very sensitive to "pure" variations in cognitive load (n-back task) in both venues
- Additive effect of venue across different secondary tasks supports the static venue as a cost-efficient alternative to the driving simulator and on-road venues in the context of industrial driver-vehicle interface evaluation
- However, this result needs to be corroborated for a greater variety of secondary tasks and driving conditions
- Unexpected "reverse" effect for SuRT Easy vs. SuRT Hard
  - Could possibly be explained in terms of increased motor interference with the DRT response (due to frequent button presses) in SuRT Easy condition
  - Needs to be further investigated - could have implications for the applicability of the DRT to tasks with strong motor demands

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