DRT sensitivity to driving demand and task difficulty

Marie-Pierre Bruyas & Laëtitia Dumont

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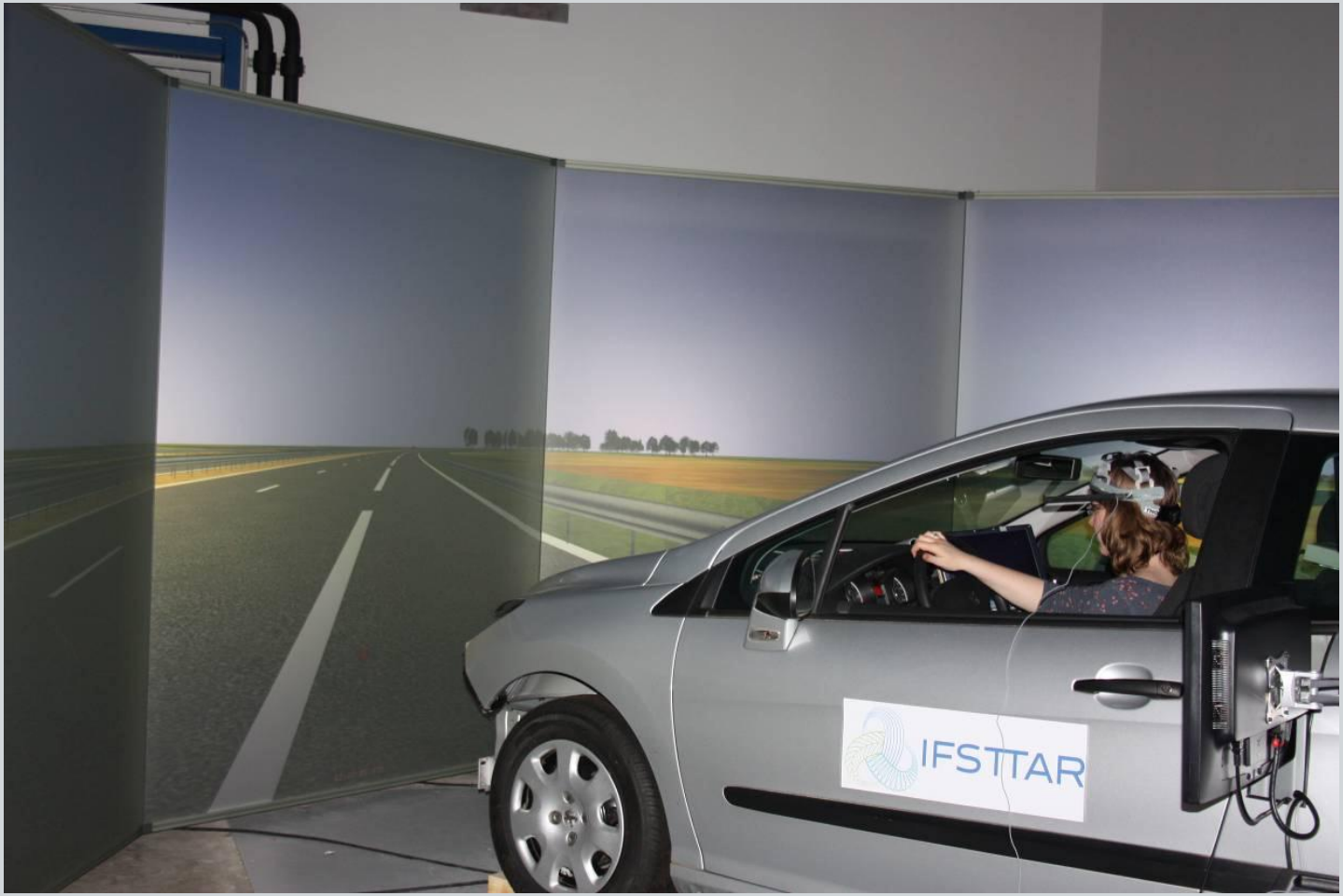
IFSTTAR

Introduction

- DRT = Detection-Response Task
- Currently discussed in ISO TC22SC13WG8
  - Developing tests inexpensive, quick to complete, easy to administer and capable of measuring aspects of drivers' distraction
- DRT to measure effects of cognitive load of a secondary task on driver's attention
  - Response to frequent stimuli (each 3 to 5 sec)
  - Performance: RT & hit rates
- Objectives
  - DRT sensitivity to **driving task demand**?
  - DRT sensitivity to secondary **task level of difficulty**?

Driving simulator



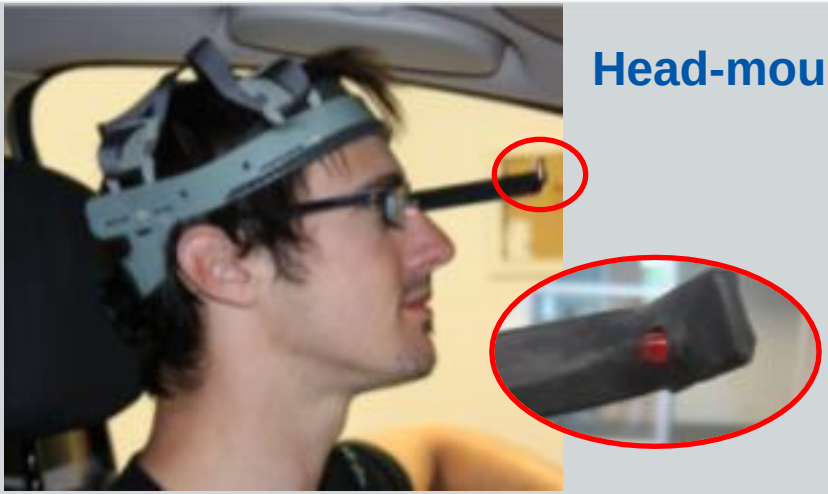
Method

- 16 participants 25-45 years old (8 males & 8 females)
- Conditions per participant
  - 4 DRT conditions: without any DRT, Head-mounted, Remote (center), Tactile

    Order counter-balanced across subjects
  - 2 driving scenarios
    - Low driving demand: Highway
    - High driving demand: Curvy road
  - 5 tasks: Ba, N0, N1, S0, S1

    Order of tasks counter-balanced across subjects and DRT
- Task duration: 60 seconds each
- RT cut-off for DRT: [100 ms-2000ms]

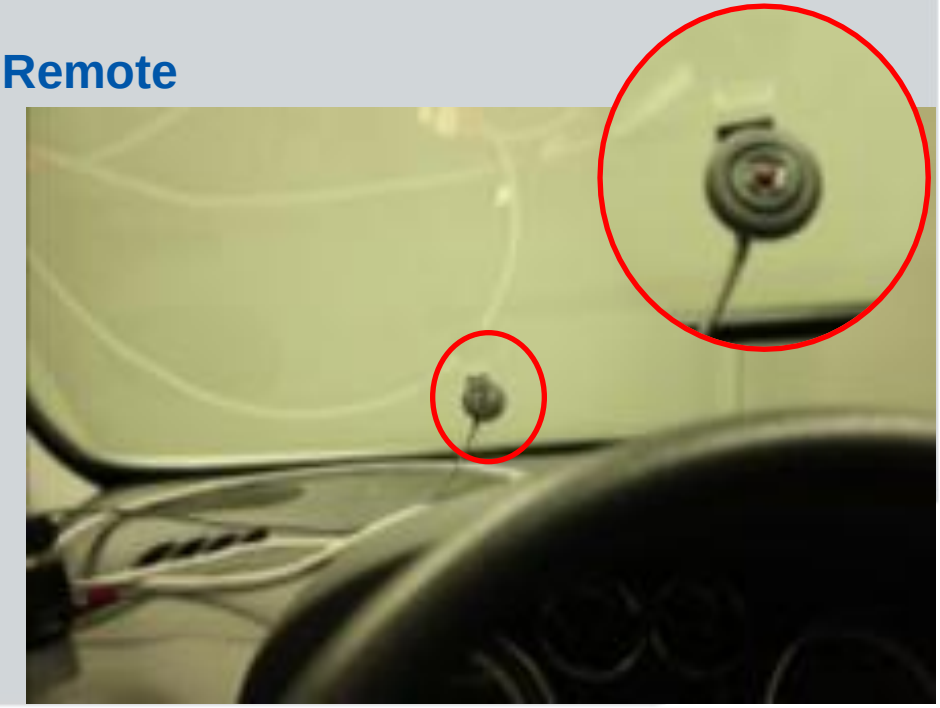
3 DRT versions



Head-mounted

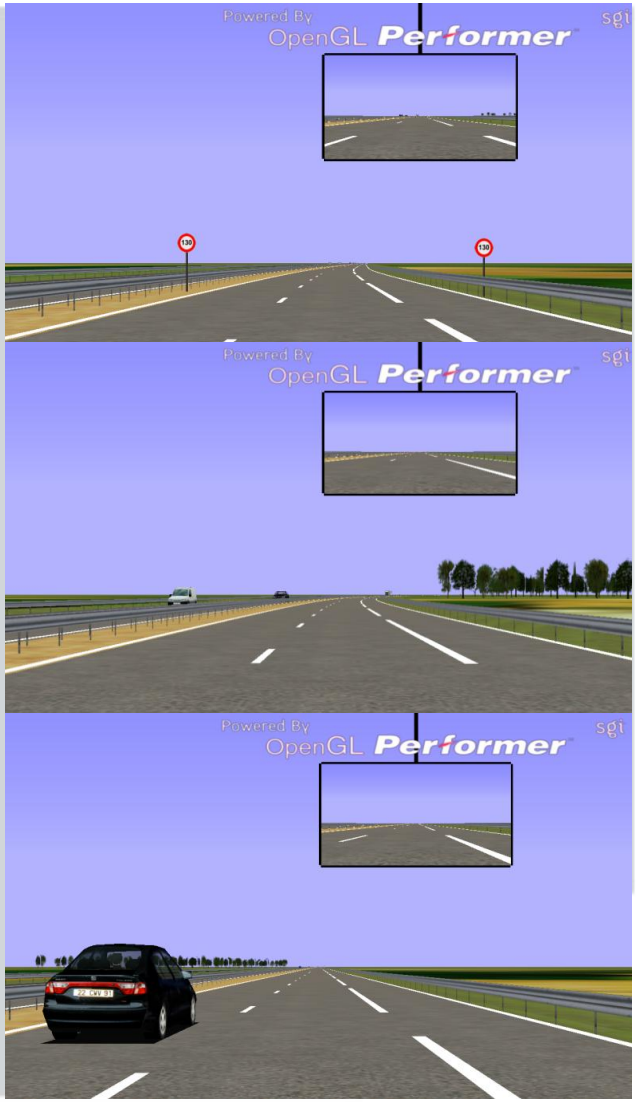
Tactile

Remote



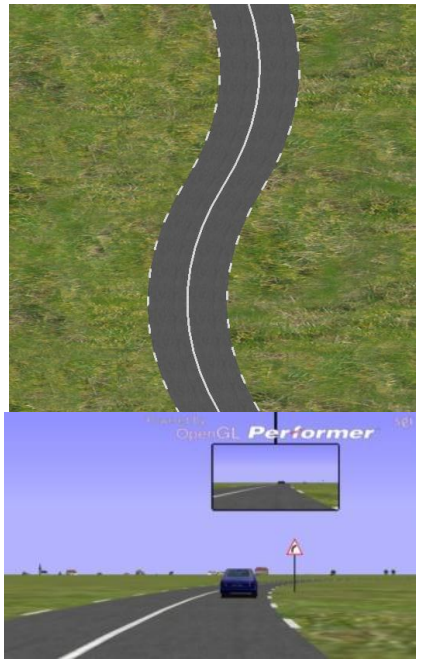
2 Driving scenarios: Highway

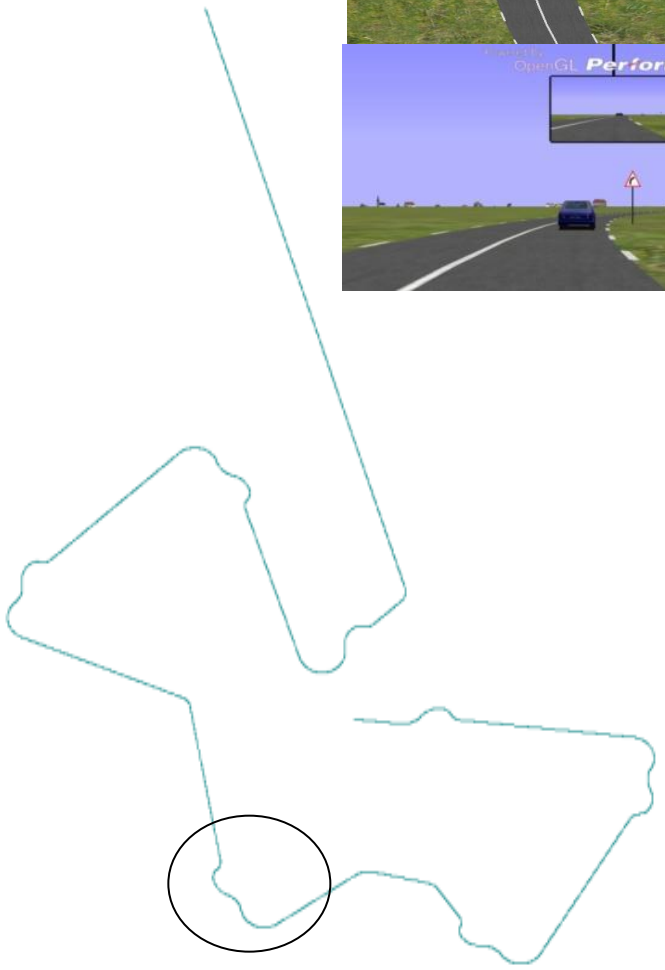
- Driving on a 2X2 lanes, speed limited to 130km/h
- Continuous drive for each DRT condition (Without DRT, HDRT, TDRT, RDT)
- 4 distractive tasks + 3 baselines
  (60s each)
- Order of tasks counter-balanced across subjects and DRT conditions
- At least 30s of driving between each task



2 Driving scenarios: Curvy road

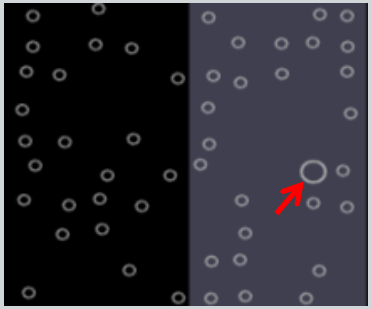
- Baselines and dual tasks in the series of curves
- Continuous drive for each DRT condition
- Same secondary tasks
- Order of tasks counter-balanced across subjects and DRT conditions
- At least 30s between each series

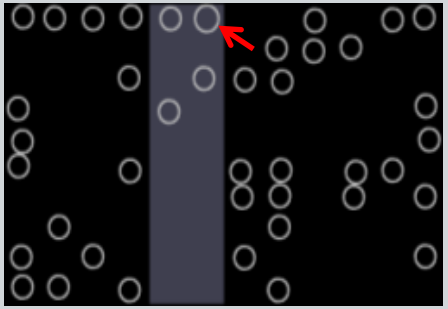




4 Distractive tasks

SuRT easy and hard





N-back easy and hard

- N0: Repeat the last number
- N1: Repeat the number heard before the last

Results: DRT Response Times

Global effects

(repeated measures Anova)

- Significant effect of **driving task demand** (*p=0,001*)
- Significant effect of **DRT version** (*p<0,001*)

  $RT_{Tactile} < RT_{Remote}$ and $RT_{\_Tactile} < RT_{Head}$ (*p<0,05*)

  no significant difference between RT_{Head} & RT_{Remote}

Results: DRT Response Times

Global effects

(repeated measures Anova)

- Significant effect of **tasks** (*p<0,001*)
- Significant differences between all tasks except $SuRT_{easy}$ & $SuRT_{hard}$

  $RT_{BA} < RT_{N0} < RT_{N1} < RT_{SuRT}$ (*p<0,05*)

Results: Miss rate

Global effects

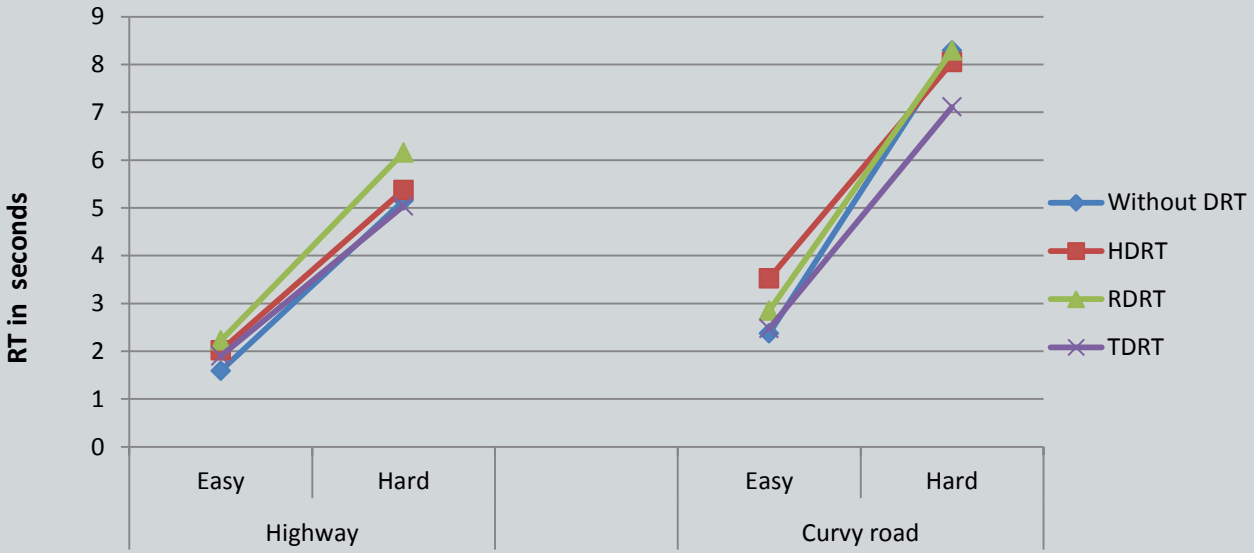
(Friedman and Wilcoxon tests)

- Significant effect of **driving task demand** (*p*<0,001)
- Significant effect of **DRT version** (*p*<0,001)
  TDRT different from HDRT & RDRT (p>0,05),
- Significant effect of **Tasks** (*p<0,05*): B < N0 <N1 < S0 < S1

Results: SURT Performance

RT per SuRT screen

(repeated measures Anova)



- Significant effect of **driving demand** (p=0,001)
- Significant effect of **DRT version** (p=0,041)
- Significant effect of **task difficulty** (p<0,001)
- **Significant interaction** of driving demand and task difficulty (p=0,001)

Results: Subjective evaluation

Subjective evaluation of difficulty to execute task(s) simultaneously

From 0 (without any difficulty) to 10 (extremely difficult)

- Significant effect of **driving demand** (p<0,002)
- Significant effect of **DRT version** (p<0,038)
  - Baseline without DRT different from all conditions (p>0,05),
  - No significant difference between DRT versions
- Significant effect of tasks (p<0,001): B < N0 <N1 < S0 < S1

Conclusions

- **DRT sensitive to the driving demand**
  - Confirmed by drivers' subjective evaluation
  - In line with other studies
- **DRT sensitive to task difficulty**
  - BA < N0 < N1 < **S0 & S1**
- **DRT sensitivity to visual-manual tasks?**
  - SuRT = driver paced task, possibility to neglect its execution and preserve DRT performance

    ⇒ participants more willing to execute SuRT easy than SuRT hard

    (DRT performances more affected in SuRT easy)

    ⇒ Necessity to address how drivers **prioritize attention** toward the tasks, especially in triple task condition
  - BUT also possible **ceiling effect** of DRT sensitivity to discriminate between tasks of too difficult levels

    ⇒ Triple task condition

    ⇒ Perceived difficulty increases between SuRT easy and hard (extremely difficult) => reach limits of resources?

Thank you!

marie-pierre.bruyas@ifsttar.fr

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