



## **Driver distraction in an unusual environment: Effects of text-messaging in tunnels**

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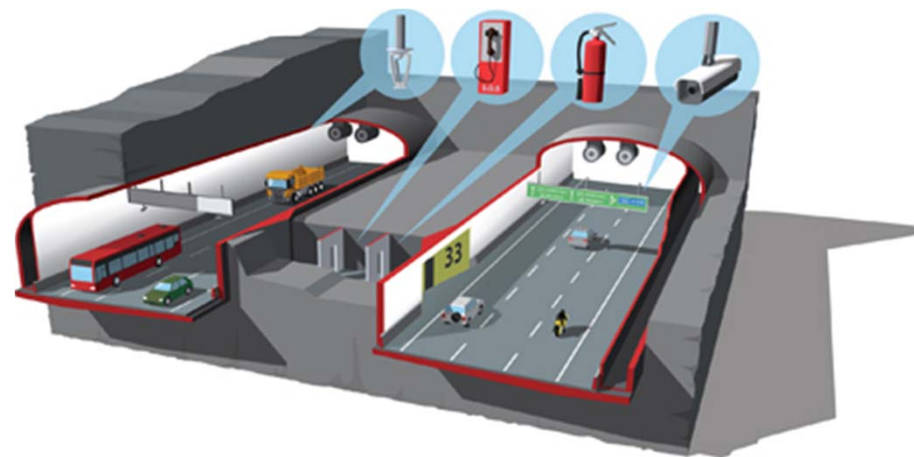
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# Background

- 🚗 **Stockholm Bypass tunnel to be completed by 2020**
- 🚗 **18 km; used by over 140,000 vehicles per day**
- 🚗 **Mobile devices → method to deliver traffic and emergency information to drivers?**
- 🚗 **Swedish VTI and STA collaboration with MUARC December 2010**



# Introduction

🚗 **Tunnels → unusual physical environment for drivers: walls, ceiling limit visual complexity; low light levels**

🚗 **Nature of driving task:**

- increased effort to maintain lateral vehicle control?
- more eye glances to centre of road?
- increased optic flow = slower speeds?



🚗 **Safety measures in tunnels → high priority**

🚗 **Text-messaging → 28% of drivers surveyed in Sweden; 25% in Australia (1.5% observed despite long-standing ban)**

🚗 **Visual-manual demands of mobile devices → selective effects on performance measures involving supervision of vehicle parameters**

# Hypotheses:

- 1. Distraction in tunnel environment would be associated with larger changes in safety-relevant driving performance than distraction on freeway:**
  - a) ↓ speed; ↑ speed variability
  - b) ↑ lateral deviation
  - c) ↑ glances (of shorter duration) to mobile phone
  - d) ↑ subjective workload
  
- 2. Regardless of road environment, text-messaging would be associated with decrements in driving performance:**
  - a) ↓ speed; ↑ speed variability
  - b) ↑ lateral deviation
  - c) ↓ glances to road ahead
  - d) ↑ subjective workload

# Method:

- 🚗 24 licensed drivers aged 25 to 55 in MUARC's advanced simulator
- 🚗 FaceLab™ measured visual scanning behaviour
- 🚗 Two, 7-km (10 min) test drives (designed according to blueprints of Bypass tunnel):





## Tunnel:



## Freeway:

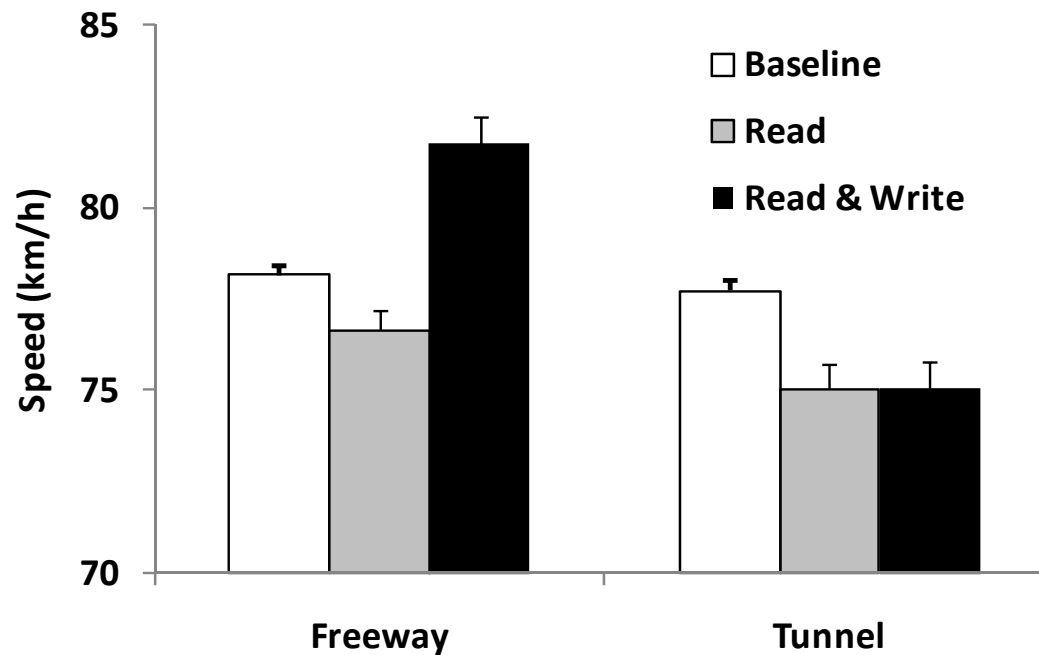


# Method:

-  **Consistent speed of 80 km/h; no interaction with traffic in adjoining lanes**
-  **Two sets of overhead signs: pre-exit (500m) and exit**
-  **Two text messages in each drive:**
  - 1. Read only (e.g., “Heavy traffic – Long delays expected. Take Sydney Harbour exit in 1 km.”)**
  - 2. Read & write (e.g., “What is the capital of Victoria?”)**
-  **Workload rating**

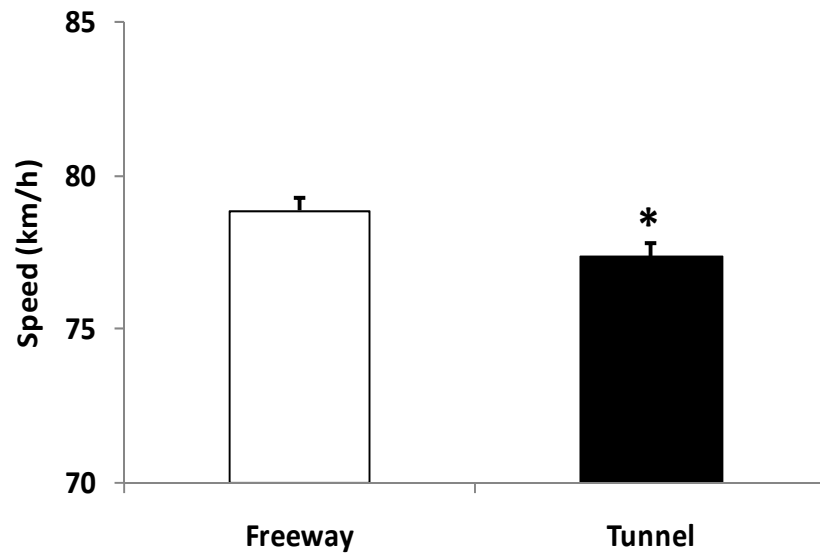
# Results: Speed

Interaction between road environment and task type on vehicle speed:

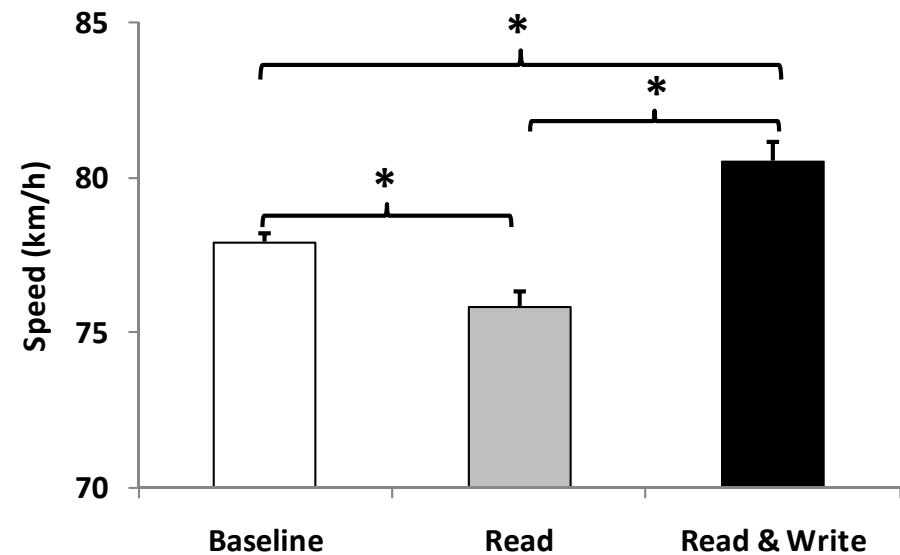


# Results: Speed

Road environment:



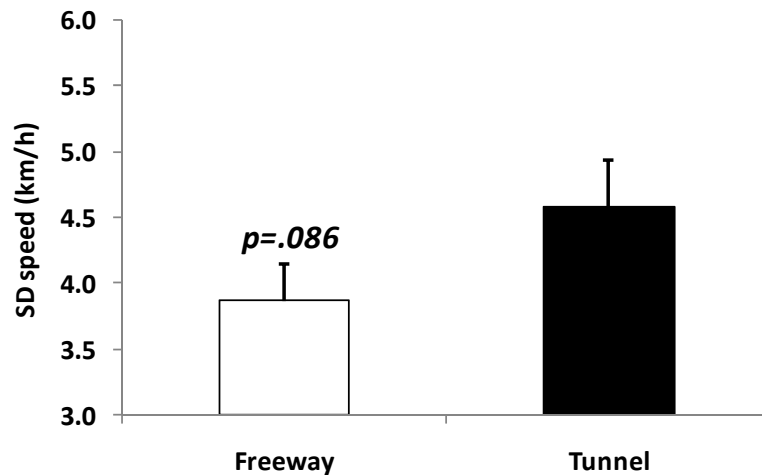
Task type:



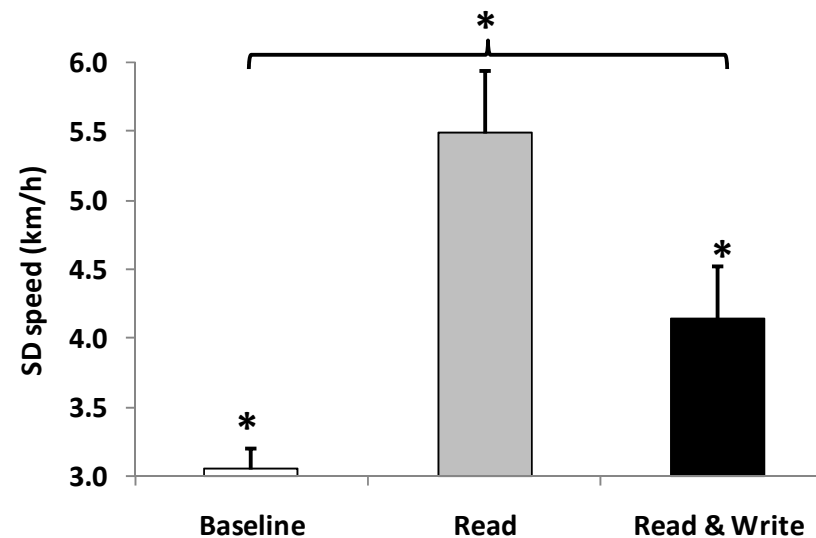


# Results: Speed variability

Road environment:

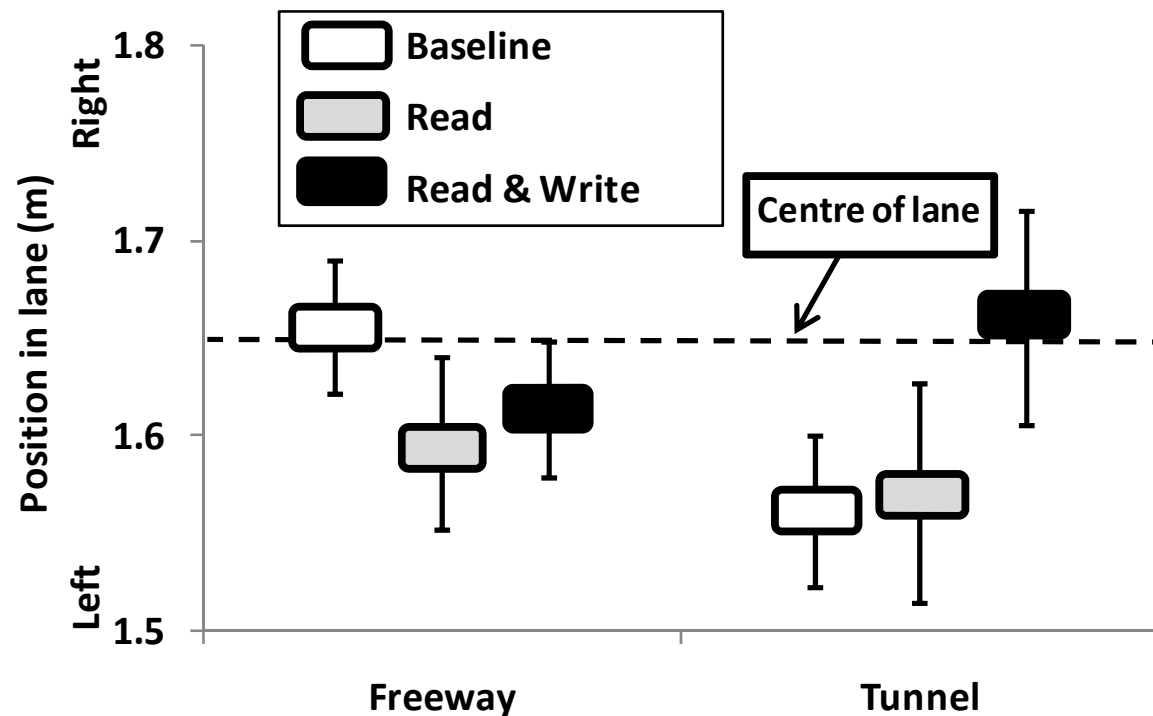


Task type:

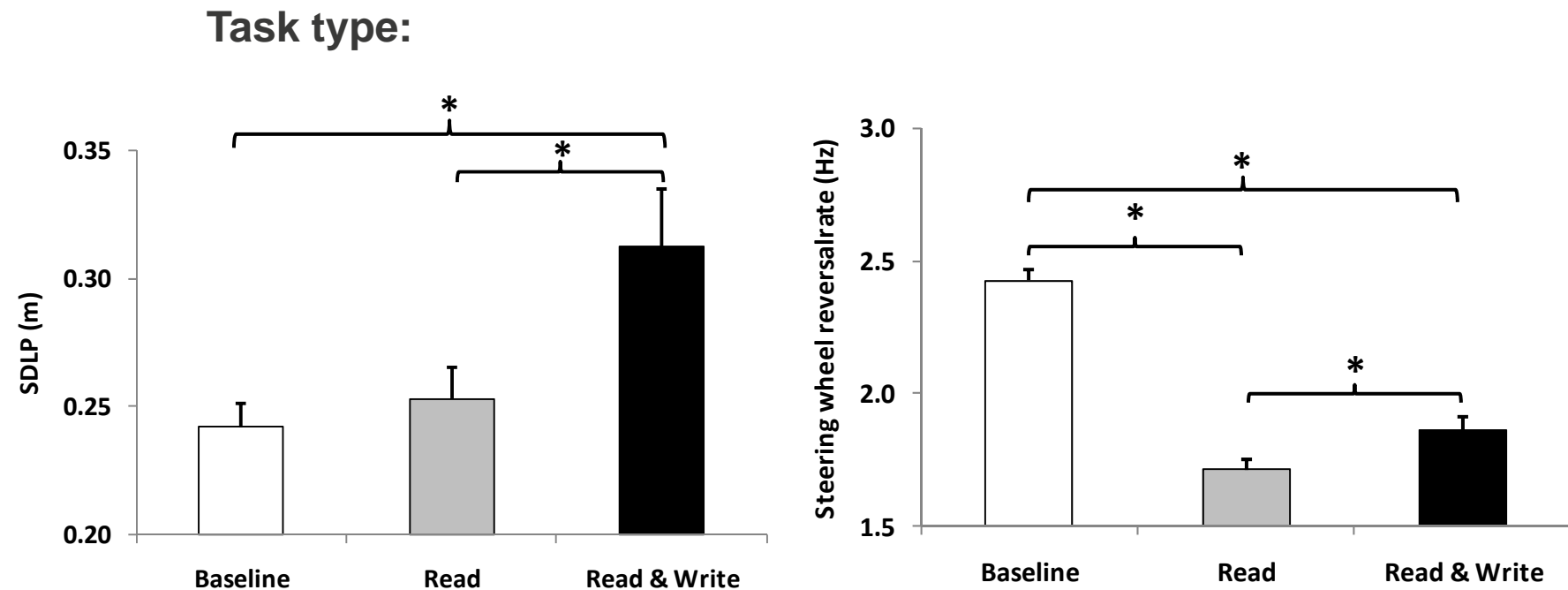


# Results: Lane position

Interaction between road environment and task type:

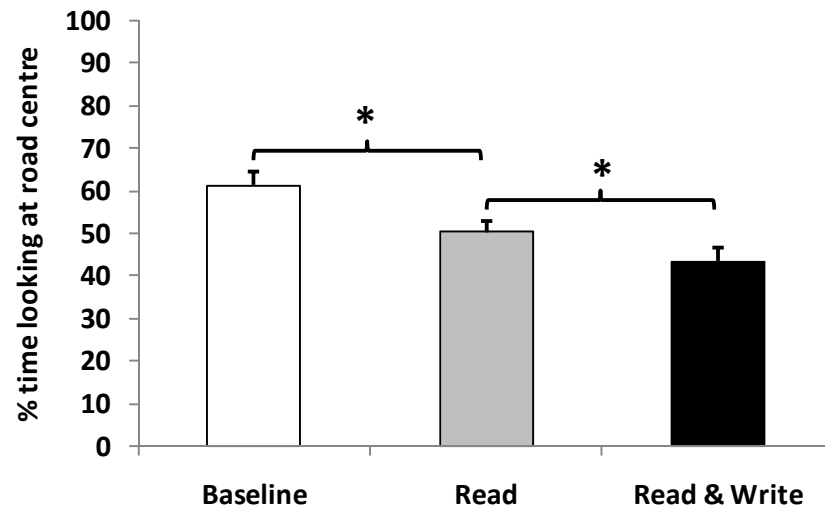


## Results: Standard deviation of lane position and steering wheel reversal rate

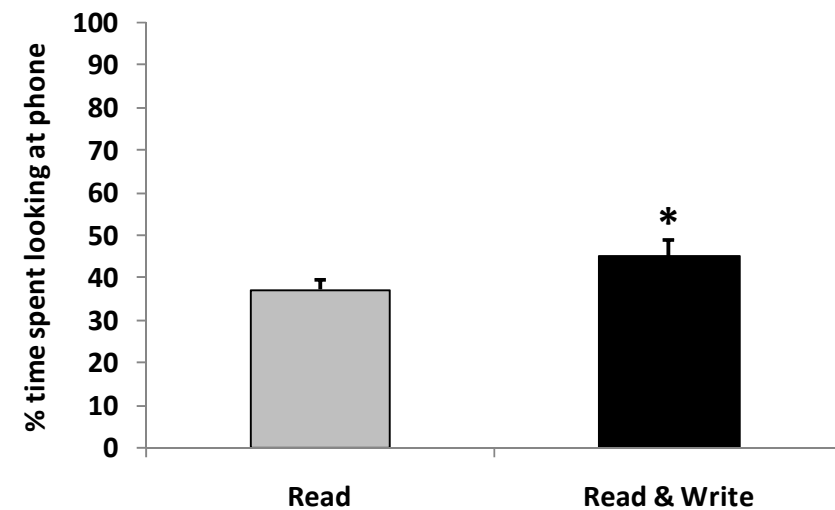


# Results: Visual scanning

Looking at road centre:

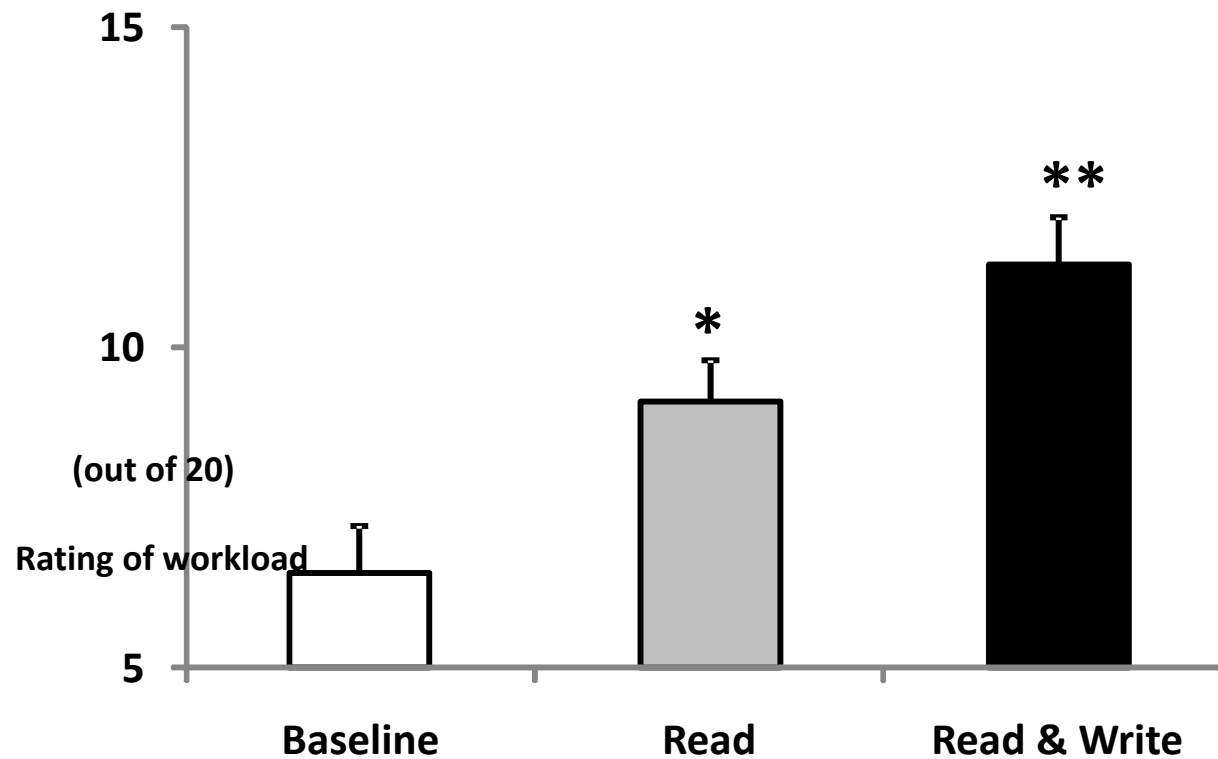


Looking at mobile phone:



# Results: Subjective workload

Task type:



# Hypotheses:

1. Distraction in tunnel environment would be associated with larger changes in safety-relevant driving performance than distraction on freeway:
  - a) ↓ speed **yes**; ↑ speed variability **no**
  - b) ↑ lateral deviation **yes**
  - c) ↑ glances (of shorter duration) to mobile phone **no**
  - d) ↑ subjective workload **no**
  
2. Regardless of road environment, text-messaging would be associated with decrements in driving performance:
  - a) ↓ speed **read only / yes in tunnel**; ↑ speed variability **yes**
  - b) ↑ lateral deviation **yes**
  - c) ↓ glances to road ahead **yes**
  - d) ↑ subjective workload **yes**

# Discussion

🚗 **Distraction affects driving performance to a similar extent in tunnel vs. on freeway – ceiling effect?**

- **Exception: slower and more central position when most distracted (sending text) in tunnel**
  - **Poor speed monitoring on freeway?**
  - **Increased perception of risk in tunnel?**

🚗 **Reading and writing text messages associated with larger decrements in driving performances than reading only:**

- **↑ subjective workload**
- **↓ time spent looking at the roadway centre**
- **↑ lane deviation**
- **↑ speed (?)**

# Discussion

- 🚗 **Main effect of road environment on speed and speed variability**
  - **Consistent with previous perceptual research on road width**
  - **Increased perception of risk?**
- 🚗 **No effect of road environment on lateral vehicle control**
- 🚗 **No effect of road environment on subjective workload**
  - **Possible that longer exposure to tunnel driving would be required**



## Conclusion:

- 🚗 **Driver distraction is equally detrimental to driving performance in tunnels as on freeways**
- 🚗 **However → tunnel environment potentially more risky (more severe crash consequences, slower emergency response / evacuation)**
- 🚗 **Drivers are (strongly) encouraged *not* to engage in text messaging or other distracting activities while driving in tunnels**



*Thank you.*

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*Tack så mycket.*