

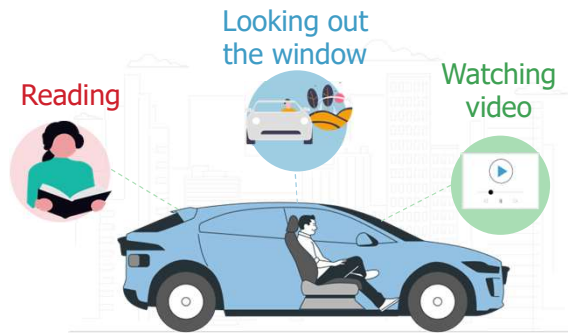
The impact of non-driving-related task engagement on the attentional processing of a novel unexpected auditory information

Yannick Lavril¹, Clément Bougard², Alexandra Fort¹, Christophe Jallais¹

¹ Laboratory of Ergonomics and Cognitive Science for Transport (LESCOT), Université Gustave Eiffel

² Stellantis - Creative center

Non-driving-related task (NDRT) during delegated driving



Engaging in NDRT

Kyriakidis et al. (2015)
Souche & Wilson (2022)



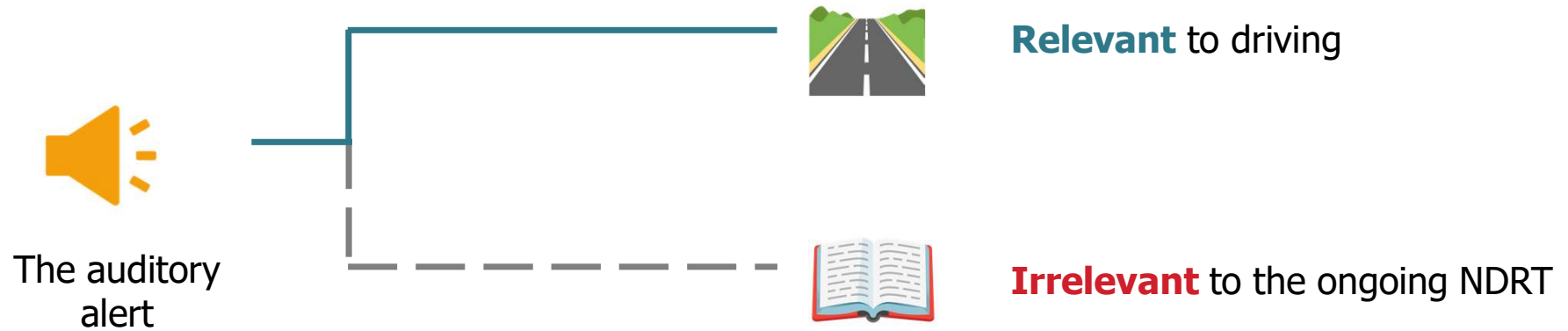
Processing an auditory
alert / pre-alert

Janssen et al. (2019)



Regaining control
of vehicle

Auditory alert and attention



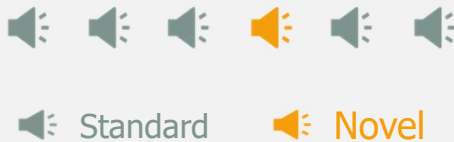
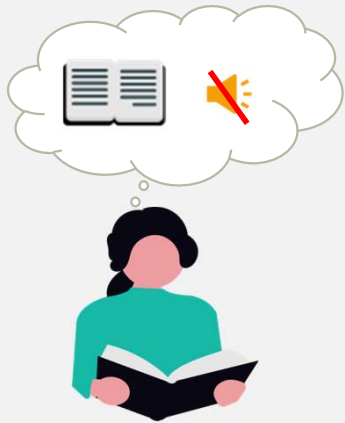
The alert must **capture attention** and **redirect it** away from the NDRT



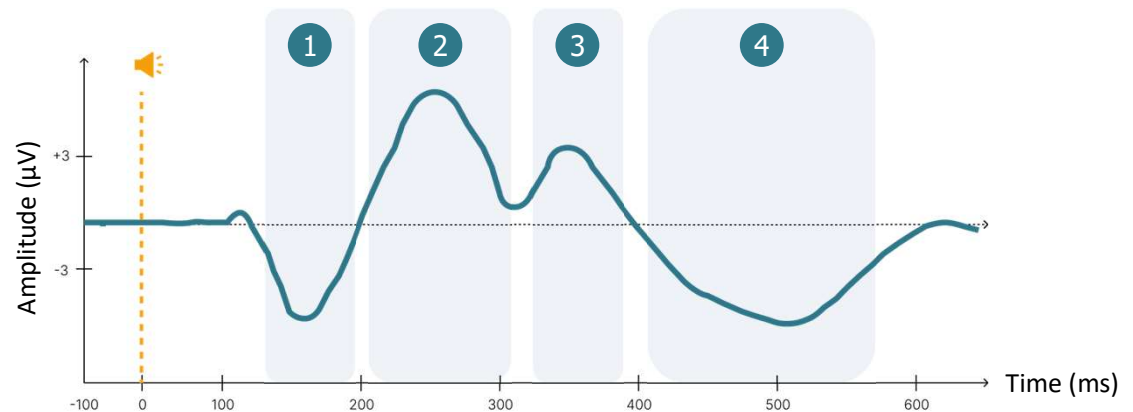
How drivers performing an NDRT process task-irrelevant sounds

Attentional processing of task-irrelevant sound

Passive auditory oddball
Papanicolaou & Johnstone (1984)

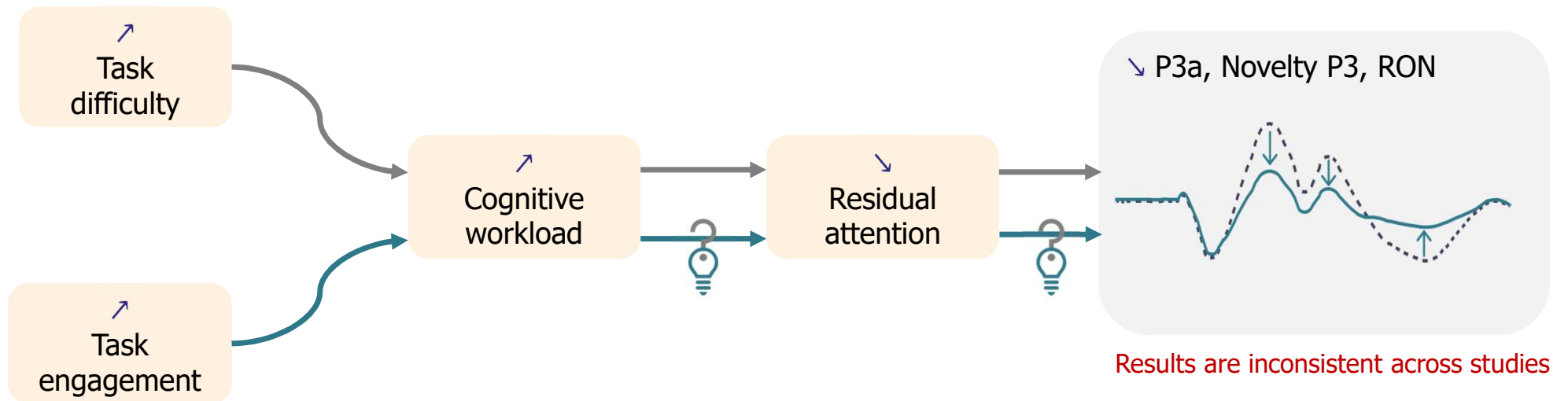


Isolating brain response to task-irrelevant sounds – Event-related potential
Brain's electrical response time-locked to a given event (Luck, 2014)



- | | | | | | | | |
|---|---------------------------------|---|---------------------------------|---|---|---|--------------------------------------|
| 1 | Early auditory change detection | 2 | Involuntary attentional capture | 3 | Additional resources to process novelty | 4 | Reorienting of attention to the task |
| | N1 / MMN | | P3a | | Novelty P3 | | RON |

Tasks modulate attentional processing

**Aim:**

Determine how different naturalistic tasks and level of engagement impact the processing of unexpected task-irrelevant sounds

Method

Procedure



N=39
(21 women, 26.4 ± 5.0 yrs)



32-channel
EEG

Video

Reading

Observation

Engagement +
(evaluated)

Engagement -
(non-evaluated)

Engagement +
(evaluated)

Engagement -
(non-evaluated)

Engagement +
(evaluated)

Engagement -
(non-evaluated)



10 min

10 min

10 min

10 min

10 min

10 min



360 standard tones



40 novel environmental
sounds

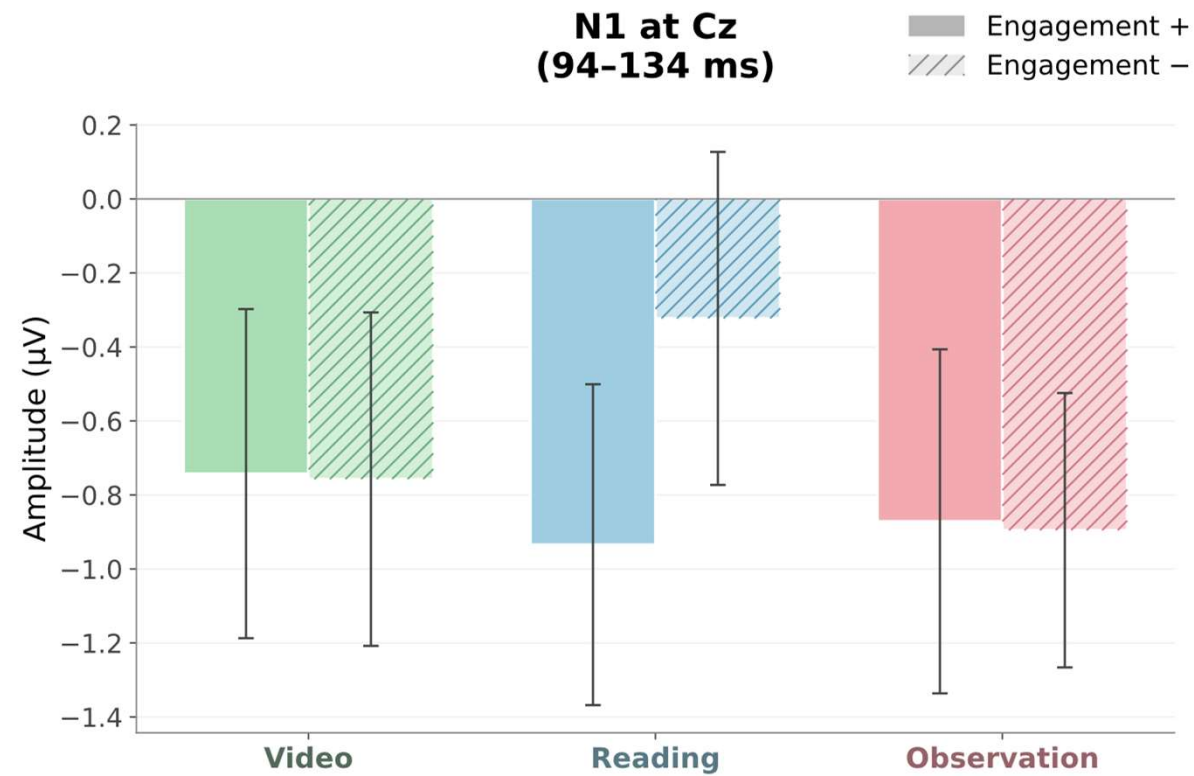


Questionnaire on task
content (post-task)



Subjective measures (post-task)

Change detection – N1

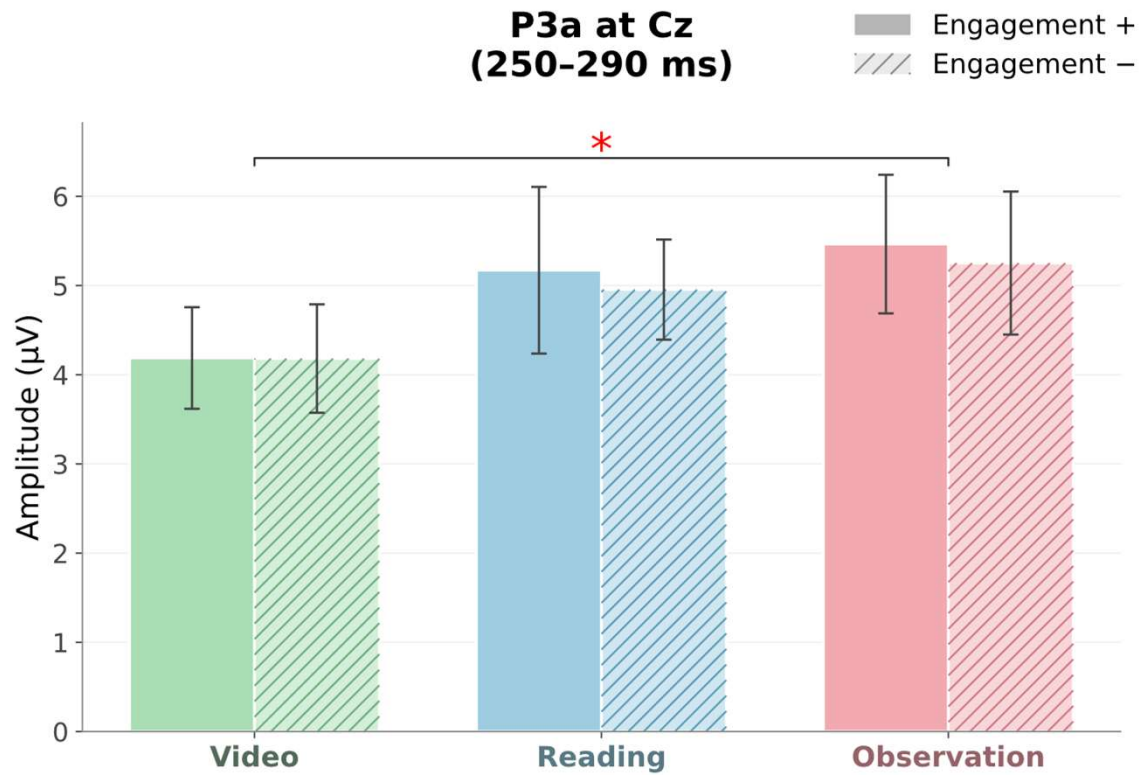
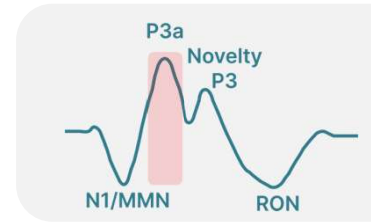


Error bars: 95% within-subject CIs

No significant effects

Similar change detection across all conditions

Involuntary attentional capture - P3a



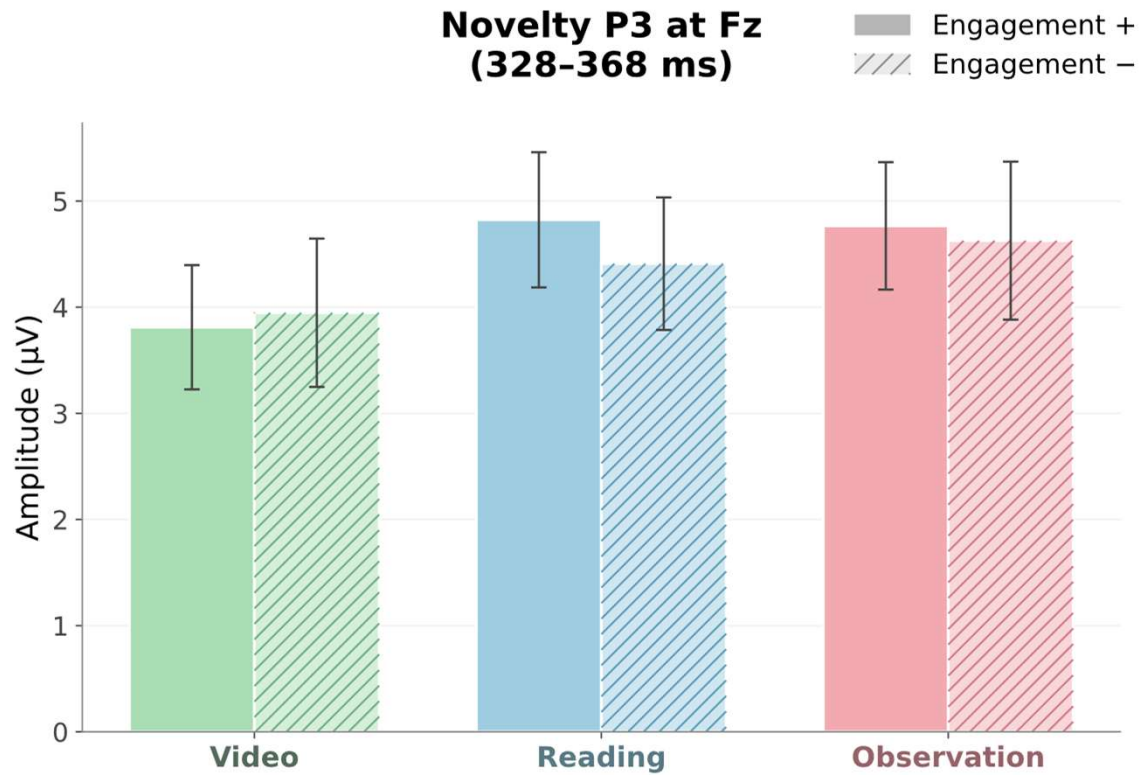
Error bars: 95% within-subject CIs

Effect of Task

$p = .023$, $D = .58$

Reduced attentional capture (P3a) for Video than and Observation

Novelty processing – Novelty P3

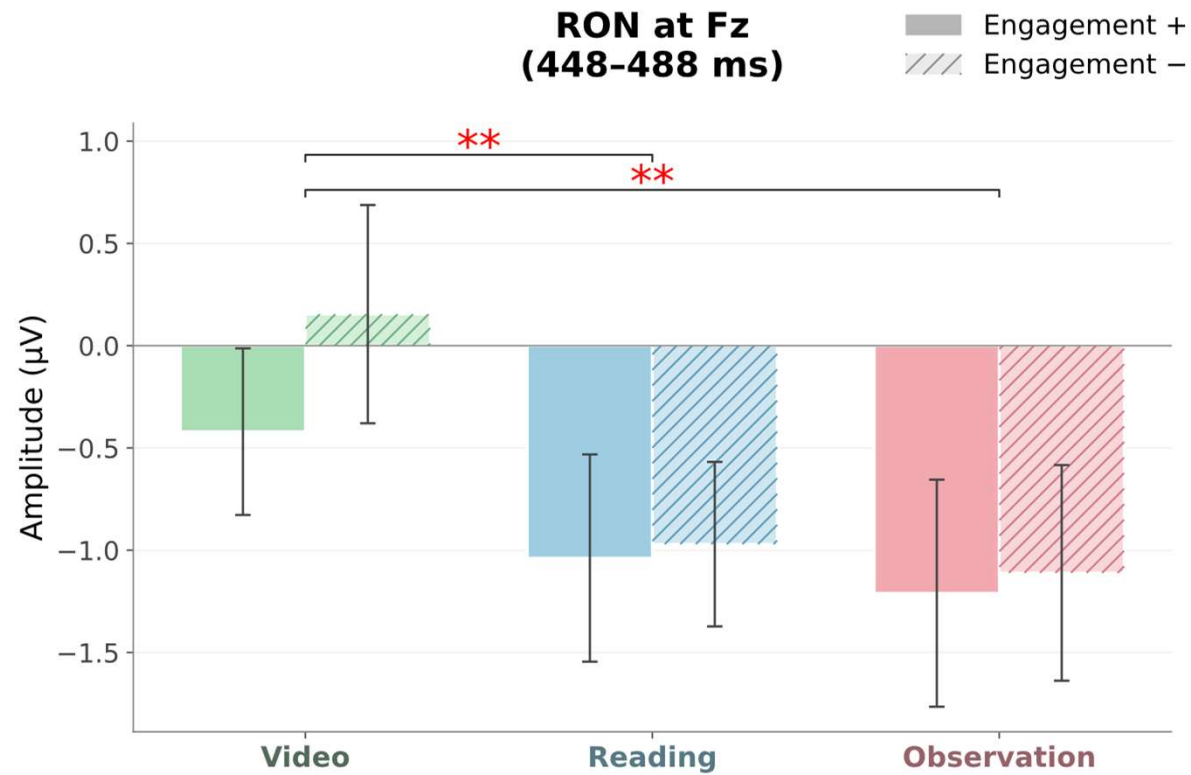
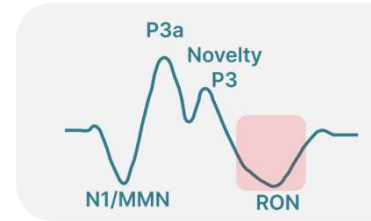


Error bars: 95% within-subject CIs

No significant effects

Similar novelty processing across all conditions

Attentional reorienting to the task - RON



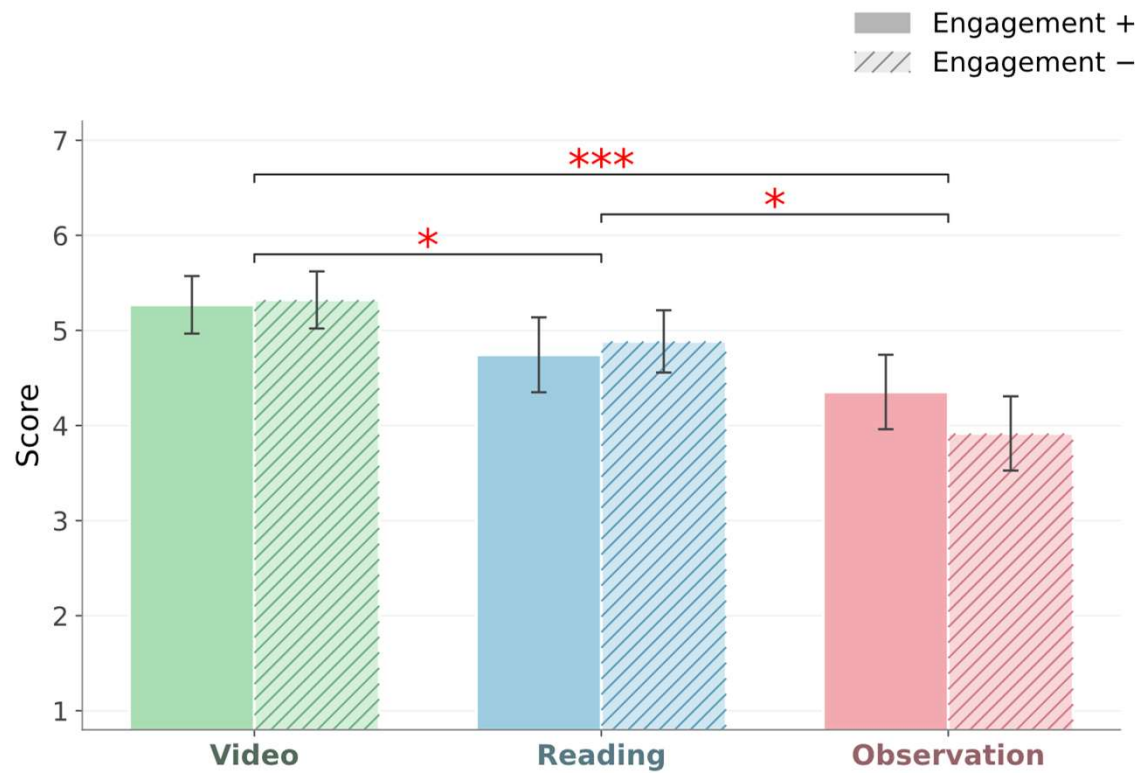
Error bars: 95% within-subject CIs

Effect of Task

$p = .001, D = .68$

Reduced reorientation (RON) for Video than for Reading and Observation

Perceived task engagement



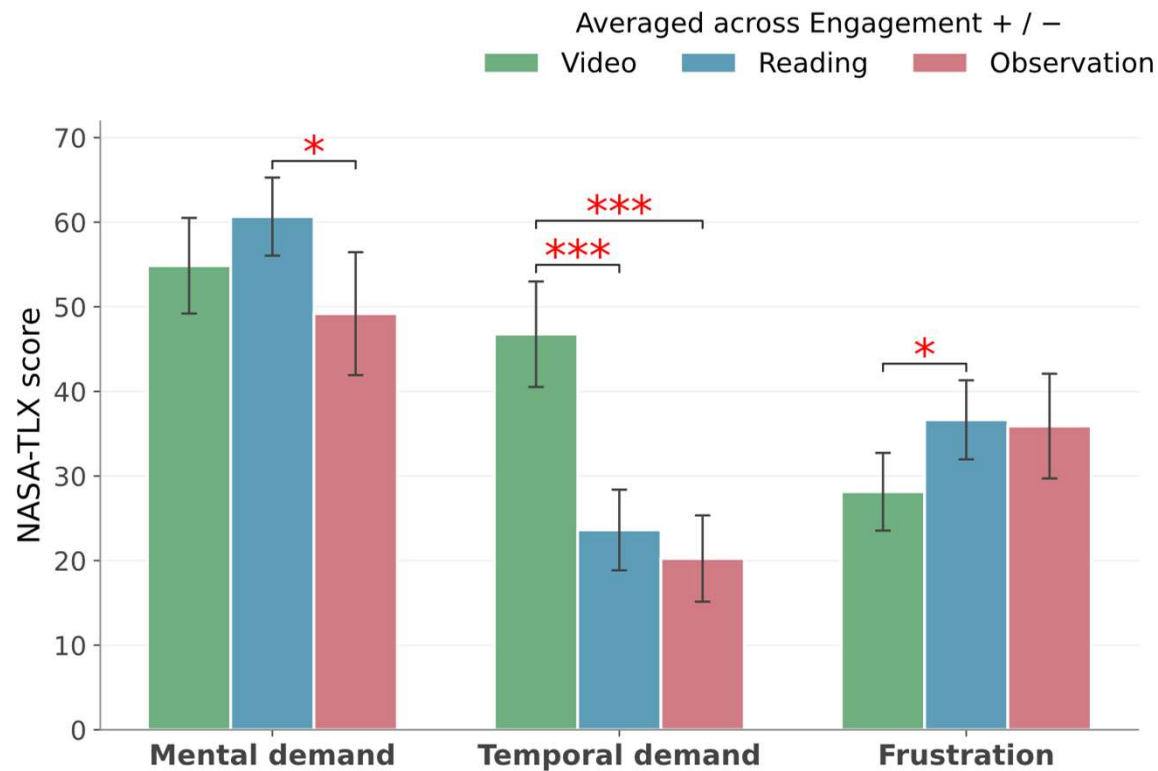
Error bars: 95% within-subject CIs

Effect of Task

$p < .001$, $\eta p^2 = .27$

Video rated as the most engaging, Observation as the least

Perceived workload – NASA-TLX



Effect of Task

Mental demand, temporal demand and frustration:
all $ps \leq .048$, $\eta p^2 =$ from .08 to .44

Effect of Engagement

All dimensions except Frustration
all $ps \leq .047$, $\eta p^2 =$ from .10 to .43

Video rated as the most time-pressured task

Discussion and perspectives

Video: less attentional capture → less need to reorient

- No evidence of higher cognitive workload
- Possibly linked to time-pressured task and engagement

Implication for delegated driving:

May keep driver more focused on the ongoing task and less sensitive to task-irrelevant

Next steps:

Could this also affect driving-relevant alerts and take-over ?

Thanks for your attention

LinkedIn



yannick.lavril@univ-eiffel.fr