

Driver gaze behaviour when monitoring for road hazards: Effects of visual distraction

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APPLY LAB



Introduction



- **Divided attention** increases likelihood of missed hazards^{1,2}, increasing collision risk.
- **Eyes-off-road (EOR) warnings** change drivers' gaze behaviour^{3,4} and may help them **attend** to the road.

Research Questions

Experiment 1: How does visual **distraction** impact drivers' **hazard localization performance**?

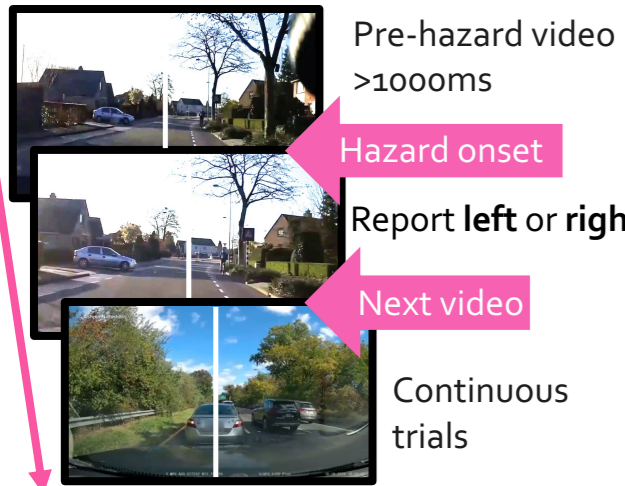
Experiment 2: Do **EOR warnings** help distracted drivers detect hazards?



Experiment 1 - Methods

Hazard Detection Task

180 videos with noise mask (2 to 8s), 50% contain hazards



Meter Task

Press spacebar when meter enters red zone



Meter moves randomly

Dual task

Hazard detection task + meter task



20 drivers
Bonus payments based on overall meter task accuracy

Hazard Examples



Experiment 2 - Methods

Dual task with EOR Warnings (1s or 1.5s)

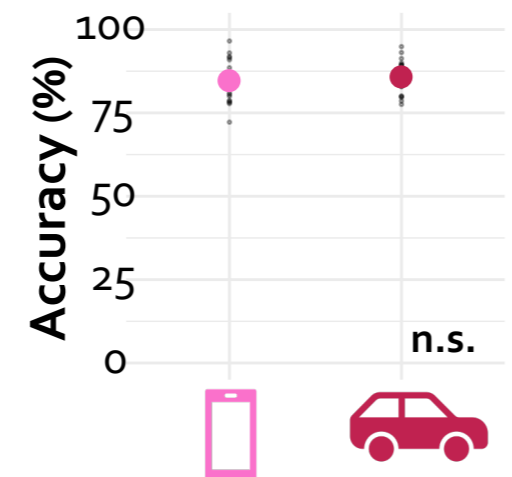
2 blocks: warning present and absent
36 drivers



Experiment 1 – Effects of distraction

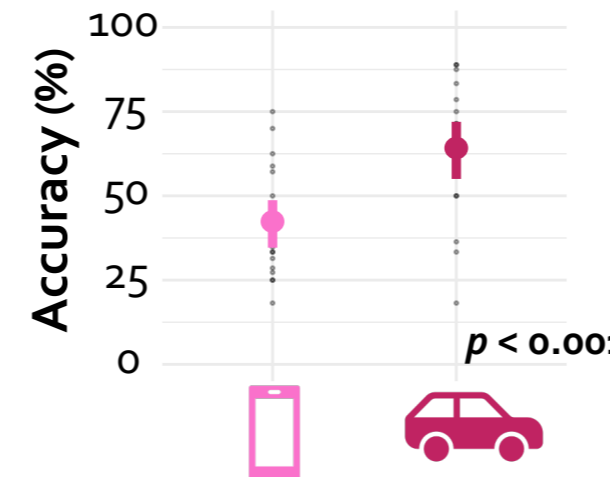
☎ Dual task 🚗 Single task

Hazard fixated 1s before response



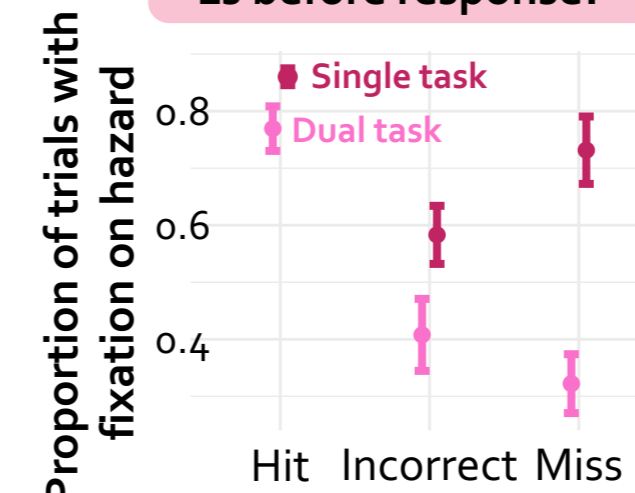
If they **fixated** on a hazard, they tended to **detect** it

Hazard NOT fixated 1s before response



Distraction **worsens hazard detection** in visual periphery

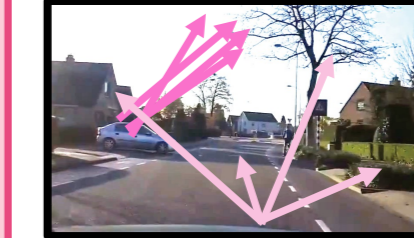
Where do drivers look 1s before response?



Distracted drivers rely more on **peripheral vision**

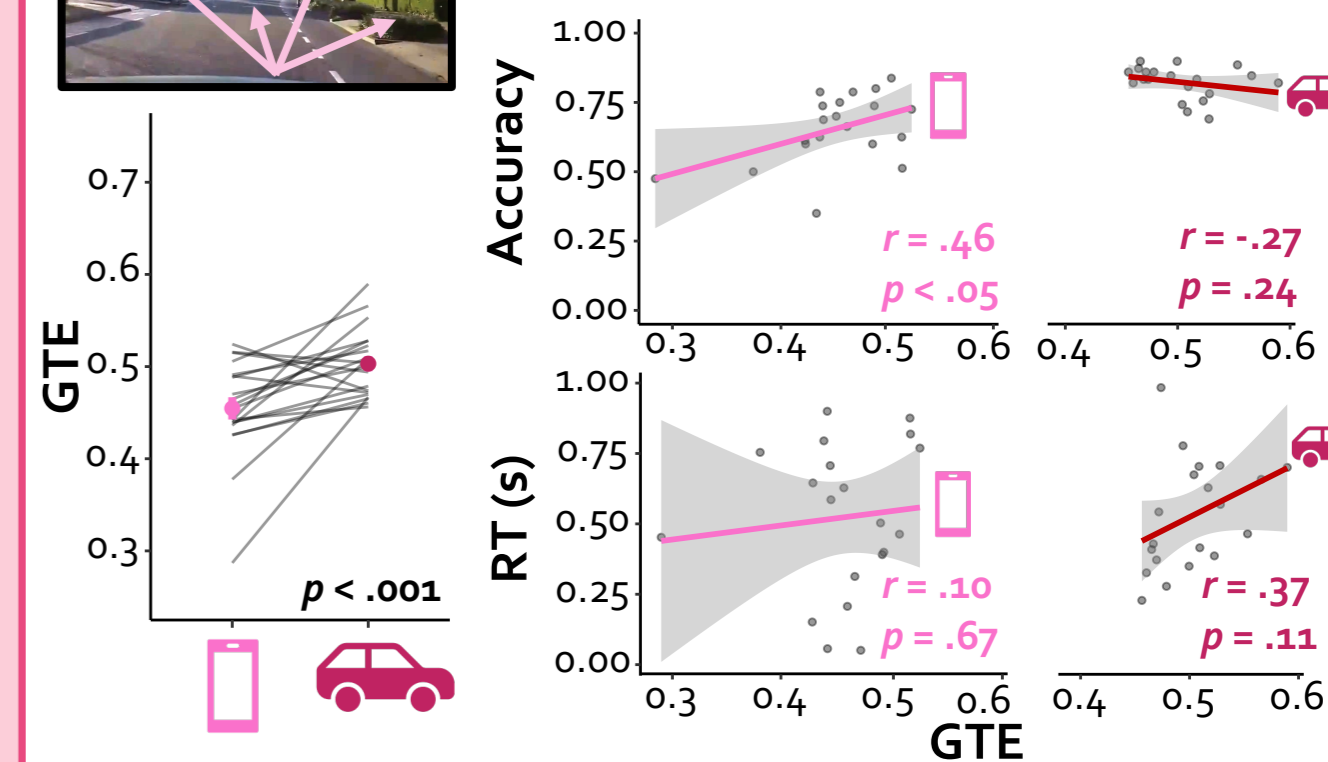
Visual distraction causes drivers to look away from the road, increasing likelihood of misses.

Experiment 1 – Gaze Transition Entropy



GTE: Randomness of saccades

→ Low GTE → High GTE

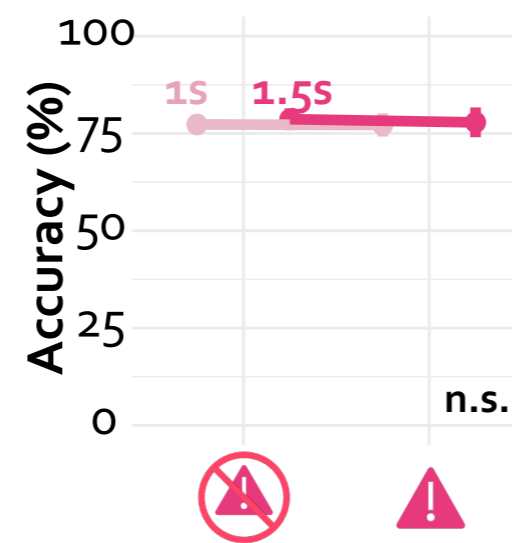


Saccades are **less predictable** in **single task** condition but GTE was **not associated** with hazard localization performance

Experiment 2 – Do warnings help?

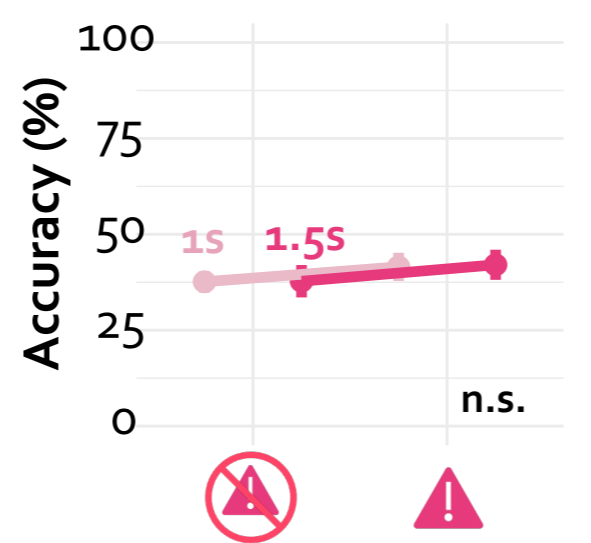
⚠ Warning absent ⚠ Warning present

Hazard fixated 1s before response

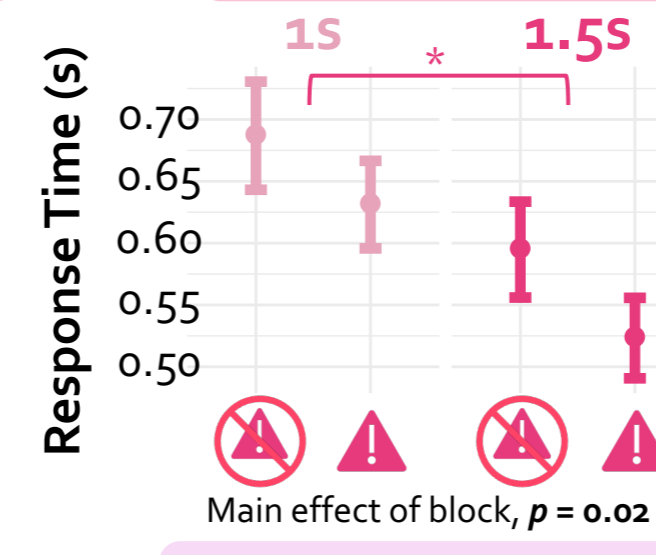


Warnings **did not help** regardless of where drivers fixated

Hazard NOT fixated 1s before response

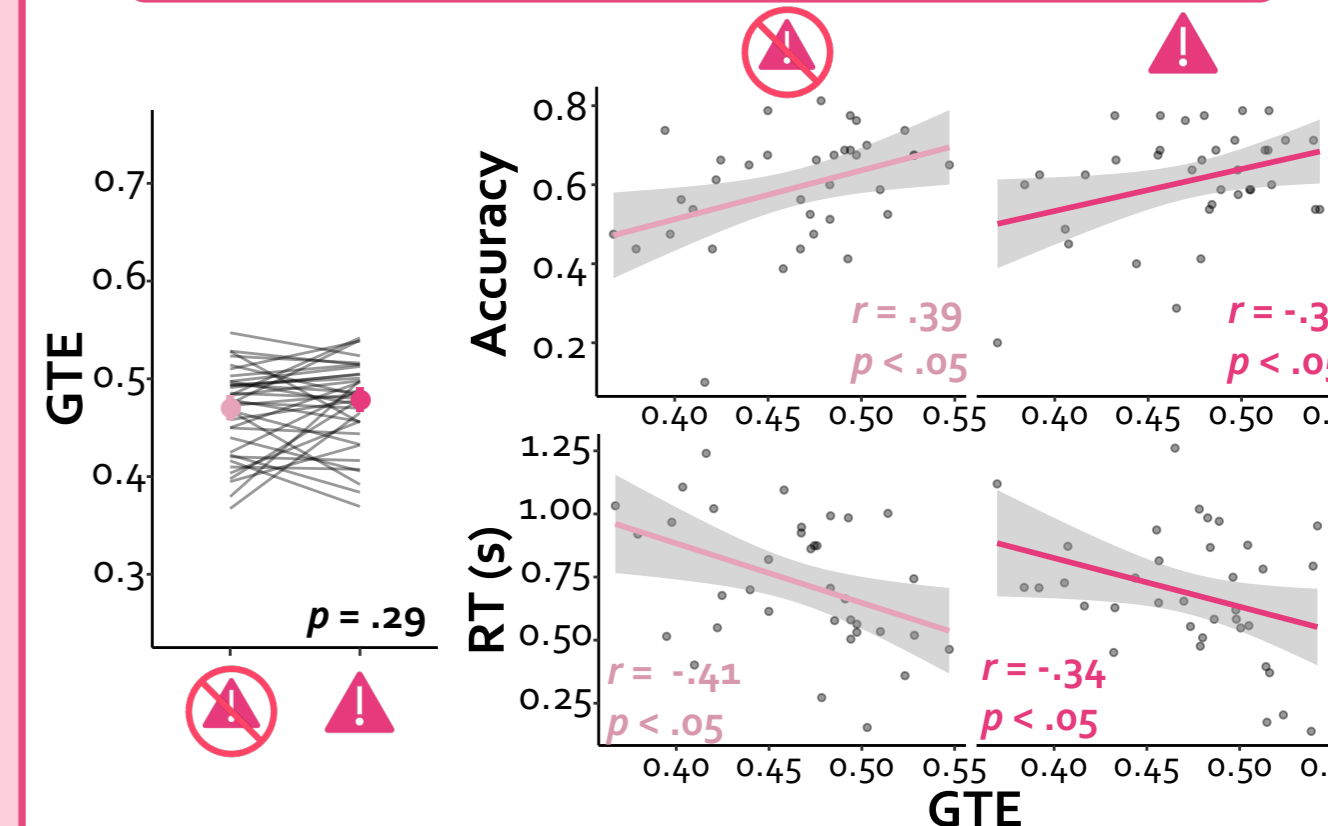


Did drivers respond more quickly?



Main effect of block, $p = 0.02$
Yes, warnings speeded hazard localization

Experiment 2 – Gaze Transition Entropy



Higher GTE associated with **better and faster hazard localization**

References: [1] D'Addario, P., & Donmez, B., *Accident Analysis & Prevention*, 127 (2019). [2] Harbluk, J.L., et al., *Accident Analysis & Prevention*, 39:2 (2007). [3] Ahlstrom, C., et al., *Transportation Systems*, 14:2 (2013). [4] Donmez, B., et al., *Accident Analysis & Prevention*, 39:3 (2007). [5] Song, J. et al., *Behav Rev* 56 (2024).