

Braking without looking:

Driver responses to sudden lead-vehicle deceleration under a forced peripheral vision paradigm

Driver Distraction & Inattention conference (DDI),
Gothenburg, Sweden
October 20, 2026

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VOLVO



You look away. The car in front suddenly brakes hard...

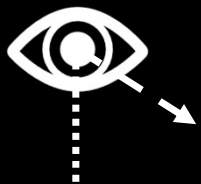


.... You don't look back. But will you brake? How fast?

What we wanted to know

*Can peripheral vision get the driver to brake in time?
How does the way we manipulate gaze shape the answer?*

Eccentricity influence



Method influence



Expectancy influence



Driving simulator study design

Setup

- Lead vehicle braking on highway
- Three groups:
 - 12°, 40° and 60°
- Two parts:
 1. Secondary-task based gaze manipulation
 2. Forced peripheral vision

Measures

- Brake response time (BRT)
- Gaze direction: On-or off road
- Presence of braking before collision

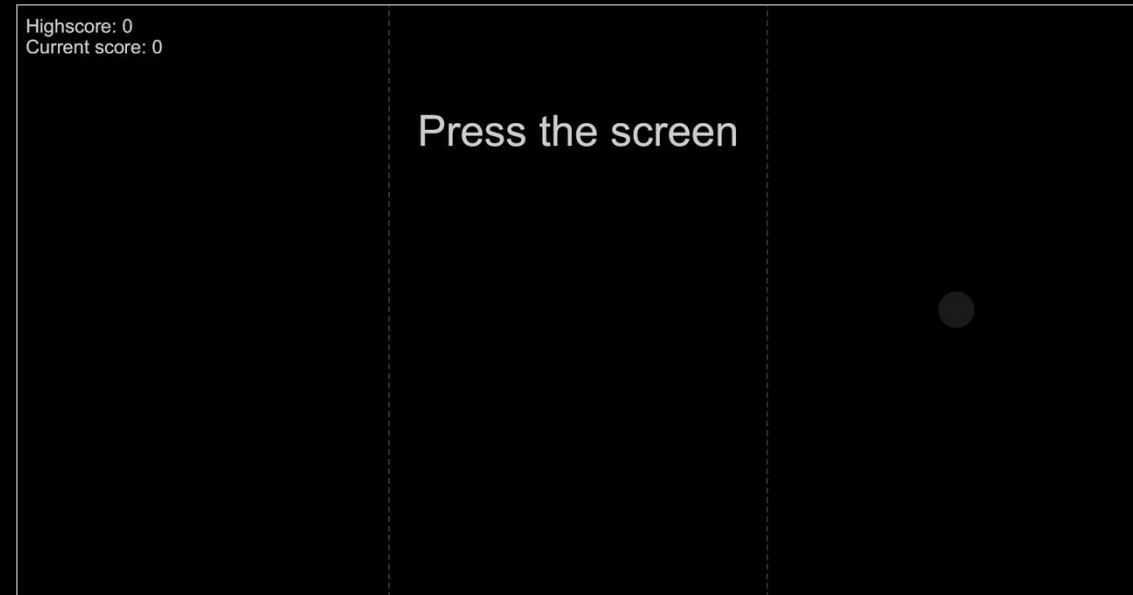
Previously unpublished part of experiment described in Svärd et al. (2021)*



*) Svärd, M., Bårgman, J., & Victor, T. (2021). Detection and response to critical lead vehicle deceleration events with peripheral vision: Glance response times are independent of visual eccentricity. *Accident Analysis and Prevention*, 150, Article 105853.

Secondary task gaze manipulation

- Self paced tracking task to make drivers look off-road
- Drawbacks :
 - Drivers rarely hold the gaze long enough
 - Short “checkglances” back toward the road



Forced peripheral vision

- Inspired by Summala and colleagues*
- Explicit instructions:
 - Hold the gaze on a display at a fixed eccentric angle
 - Brake without first looking back at the road
- Potential drawback: Loss of naturalism

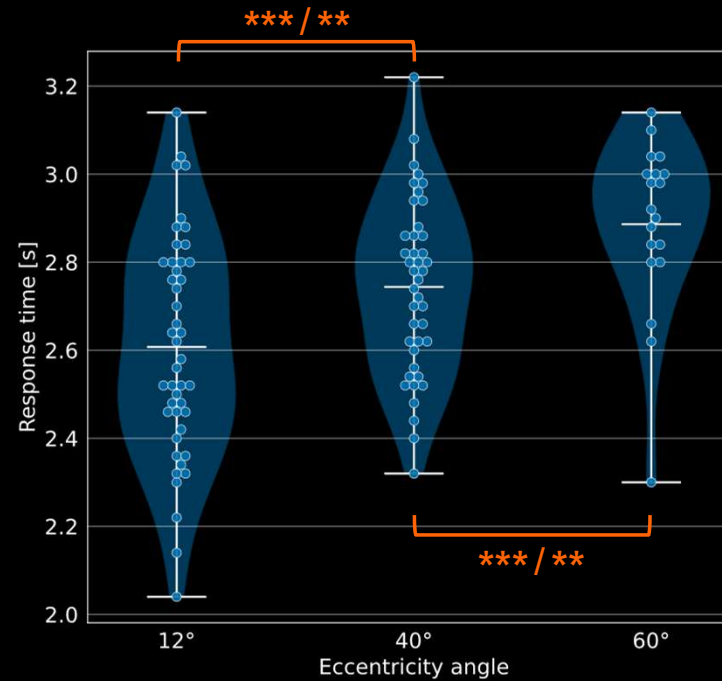
*) Lamble, D., Laakso, M., & Summala, H. (1999). Detection thresholds in car following situations and peripheral vision: implications for positioning of visually demanding in-car displays. *Ergonomics*, 42(6), 807–815

Summala, H., Lamble, D., & Laakso, M. (1998). Driving experience and perception of the lead car's braking when looking at in-car targets. *Accident Analysis & Prevention*, 30(4), 401–407

Summala, H., Nieminen, T., & Punto, M. (1996). Maintaining lane position with peripheral vision during in-vehicle tasks. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 38(3), 442–451



Brake response times slow with eccentricity



*** ANOVA, $p < 0.001$

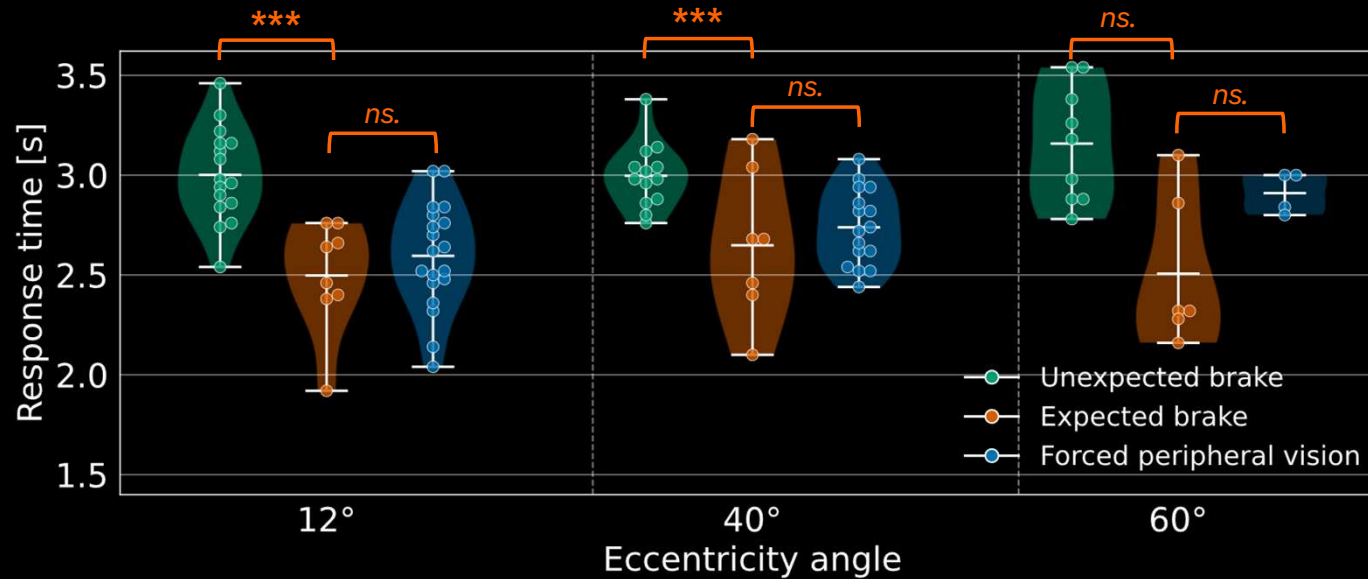
** Pairwise Mann-Whitney, $p < 0.010$

Clear group effect

All groups are separated

Confirms earlier research

Expectancy matters more than method

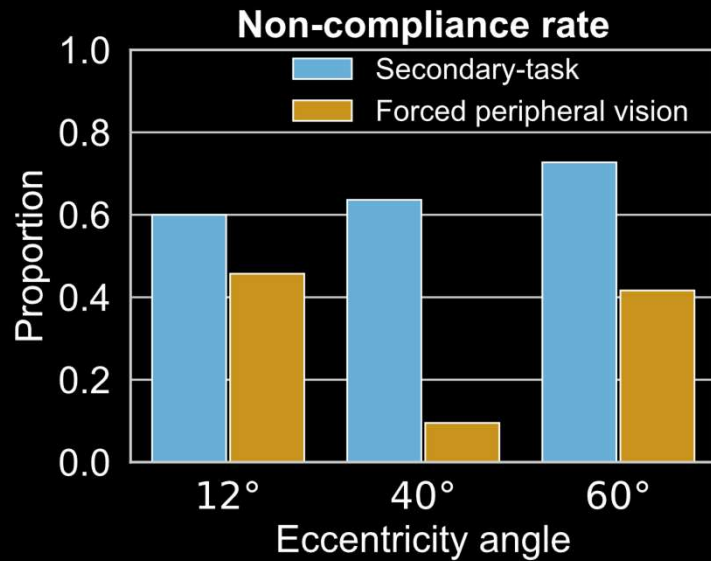


Method: no difference

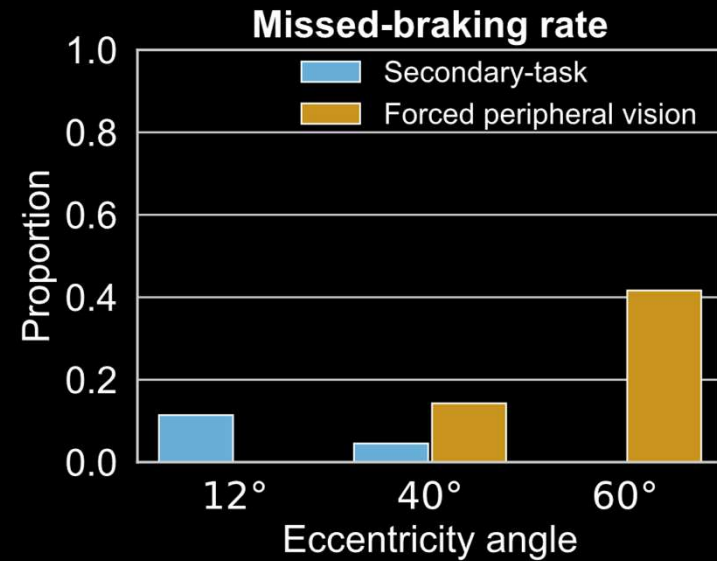
Expectancy: large difference

Underestimation risk

Forced peripheral paradigm yields better gaze control — but at a cost



Compliance improves...



...but some drivers hesitate to brake

What does this mean in practice?



Driver models

- Effects of gaze location
→ increased realism



DMS and ADAS

- Gaze direction as a graded risk signal
- Expected-condition data should *not* be used for surprising events



Study design

- Choose the gaze-manipulation method deliberately.
- Compliance and general behavior may be as important as BRT

Conclusions



Eccentricity

- Drivers can use peripheral vision to brake



Method

- Comparable brake response times across methods
- Shapes compliance and response tendency



Expectancy

- Expectancy → quicker responses



Back to that car...



You probably manage to brake. Just later.

V O L V O