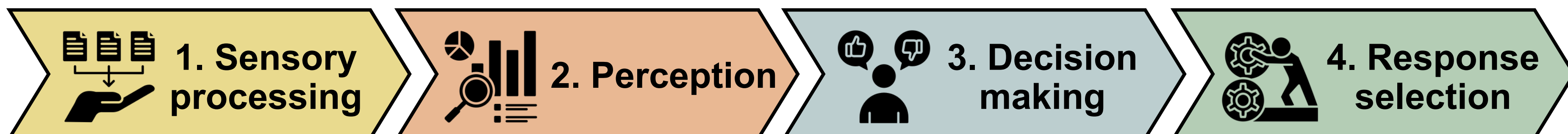


Introduction

Driving involves a sequence of related stages typical of the so-called **human information processing** (HIP, Parasuraman et al., 2000).



- In-vehicle technologies can increase visual and cognitive demands, interfering with roadway information processing.
- Head-up displays keep information within the driver's field of view, but poor information design may increase workload.
- **Adaptive automation** selectively supports different HIP stages while keeping the driver involved in vehicle control (Kaber et al., 2005).

Improving driving safety requires not only introducing new technologies but also designing them according to the way humans naturally process information, supporting specific cognitive functions involved in driving.

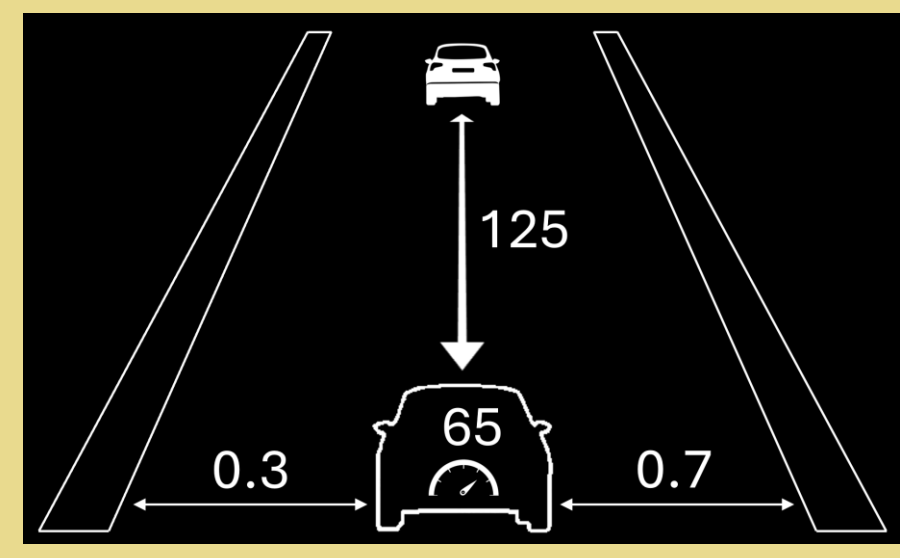
This driving simulation study examined how the **adaptive automation** of the different stages of the **human information processing** affects driving performance on motorways.

Methods

5 different automated HIP levels.

0. Baseline
(manual control driving)

1. Information acquisition

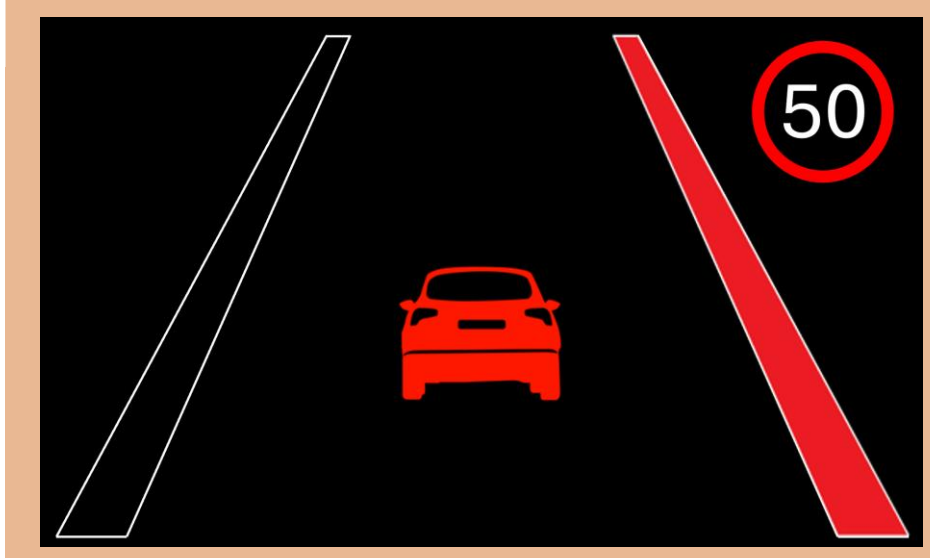


Multi-level mixed factorial design

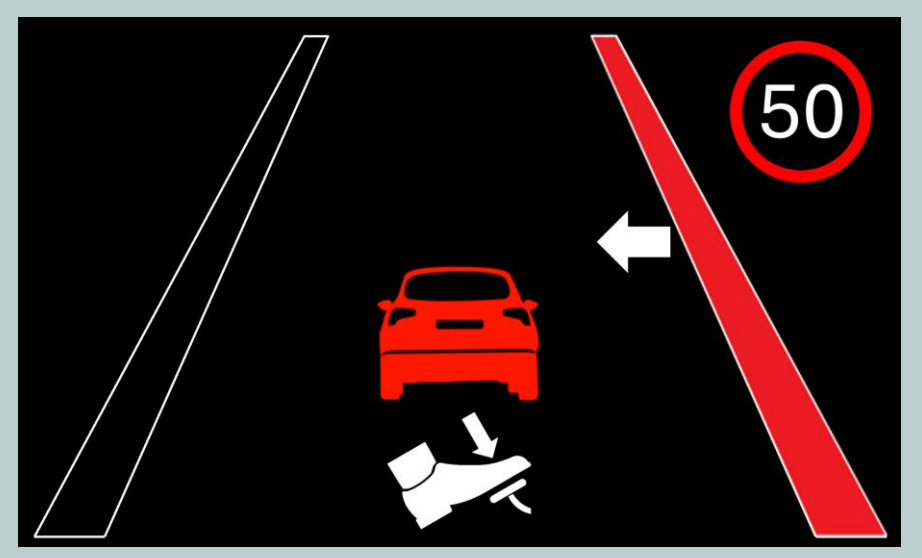
32 participants (16 females). Age: M = 38.6 y, SD = 12.0 y.

Road scenario: 8-km motorway scenario under low (LOS A) and high (LOS C) traffic conditions.

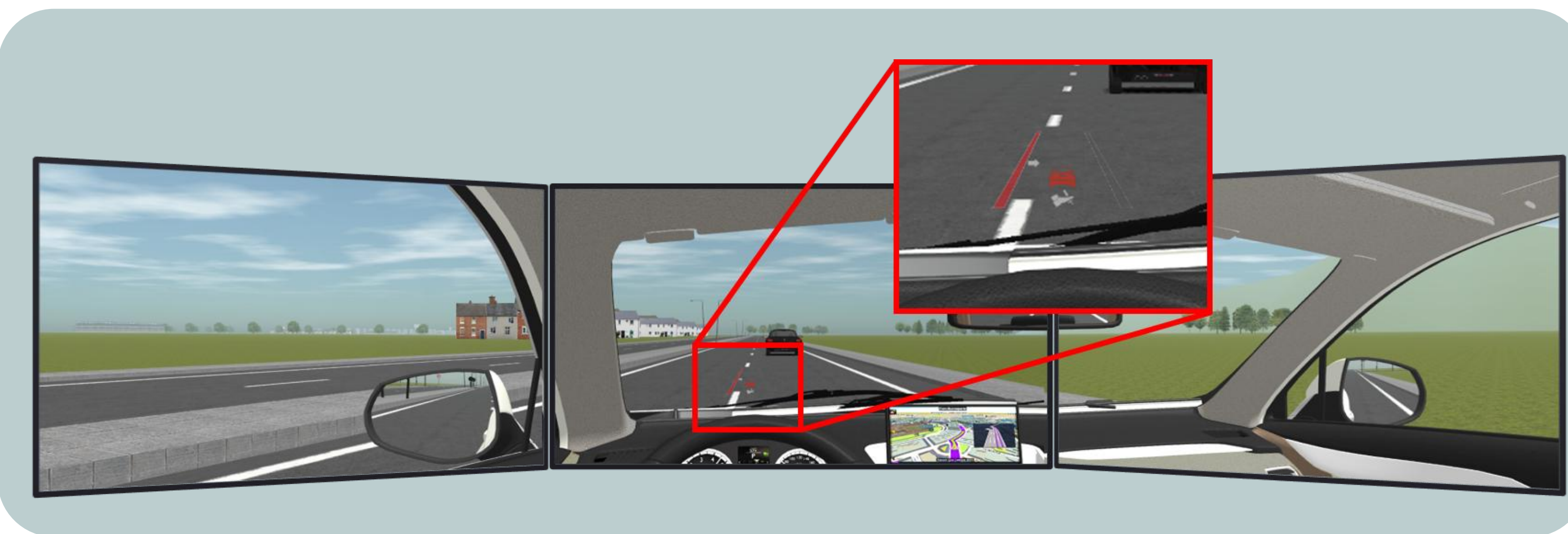
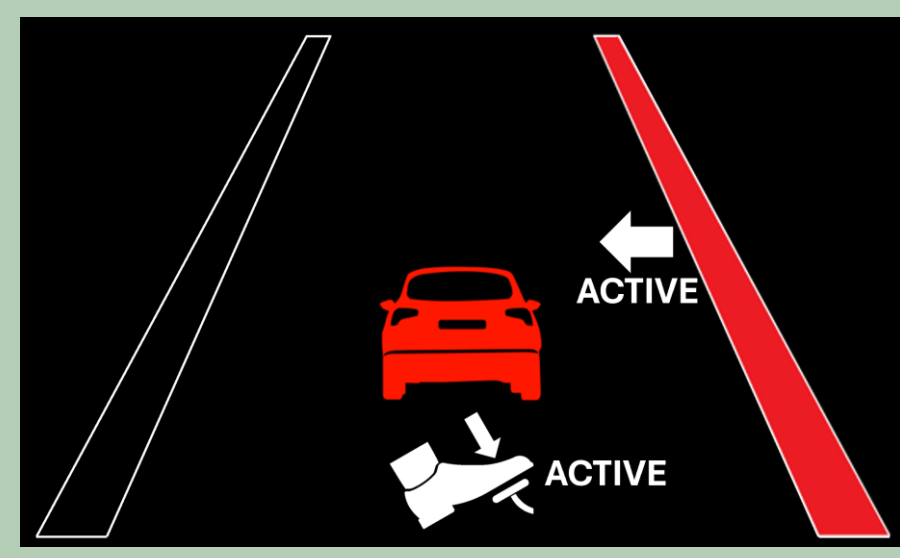
2. Information analysis



3. Decision selection

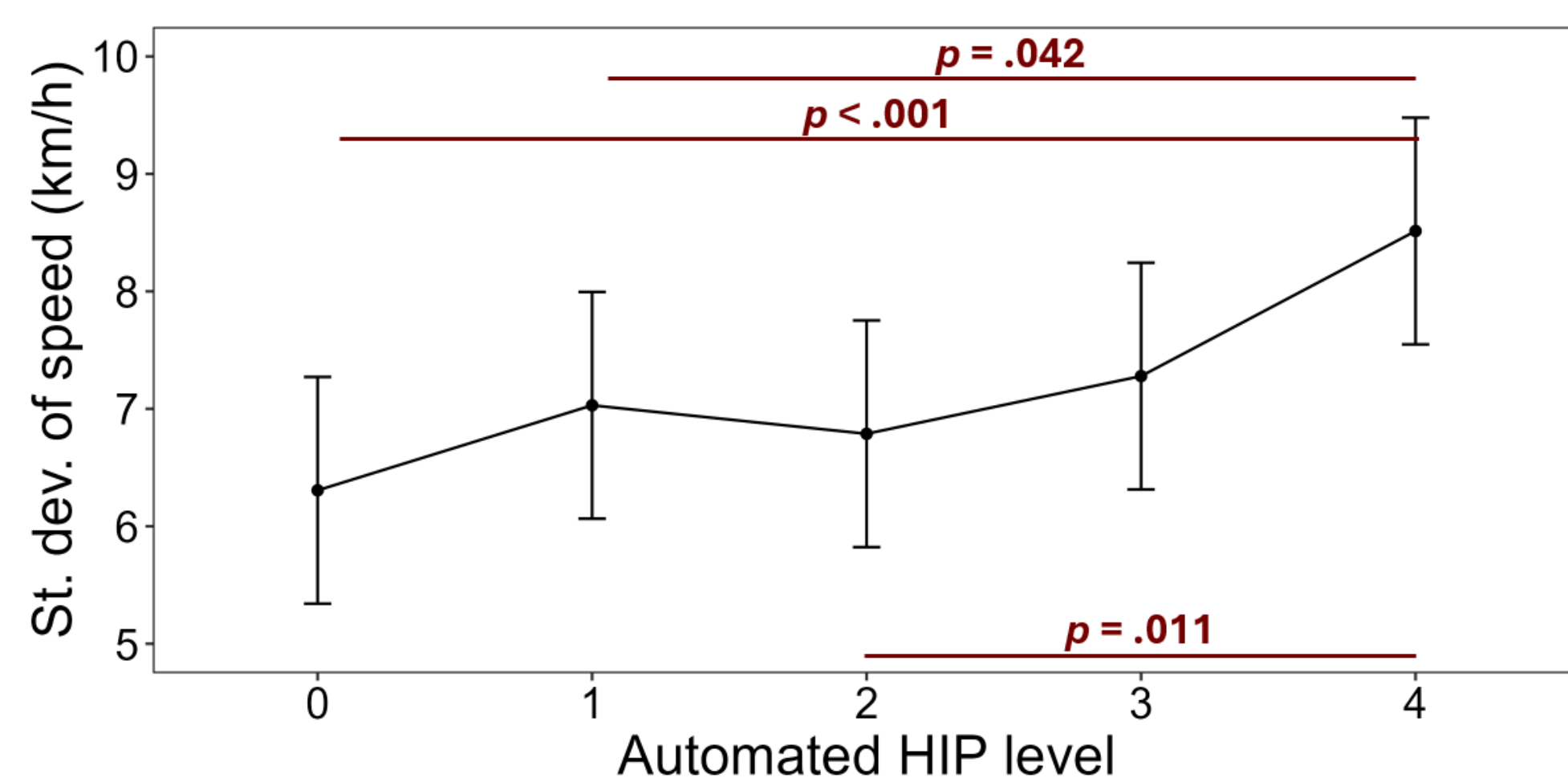
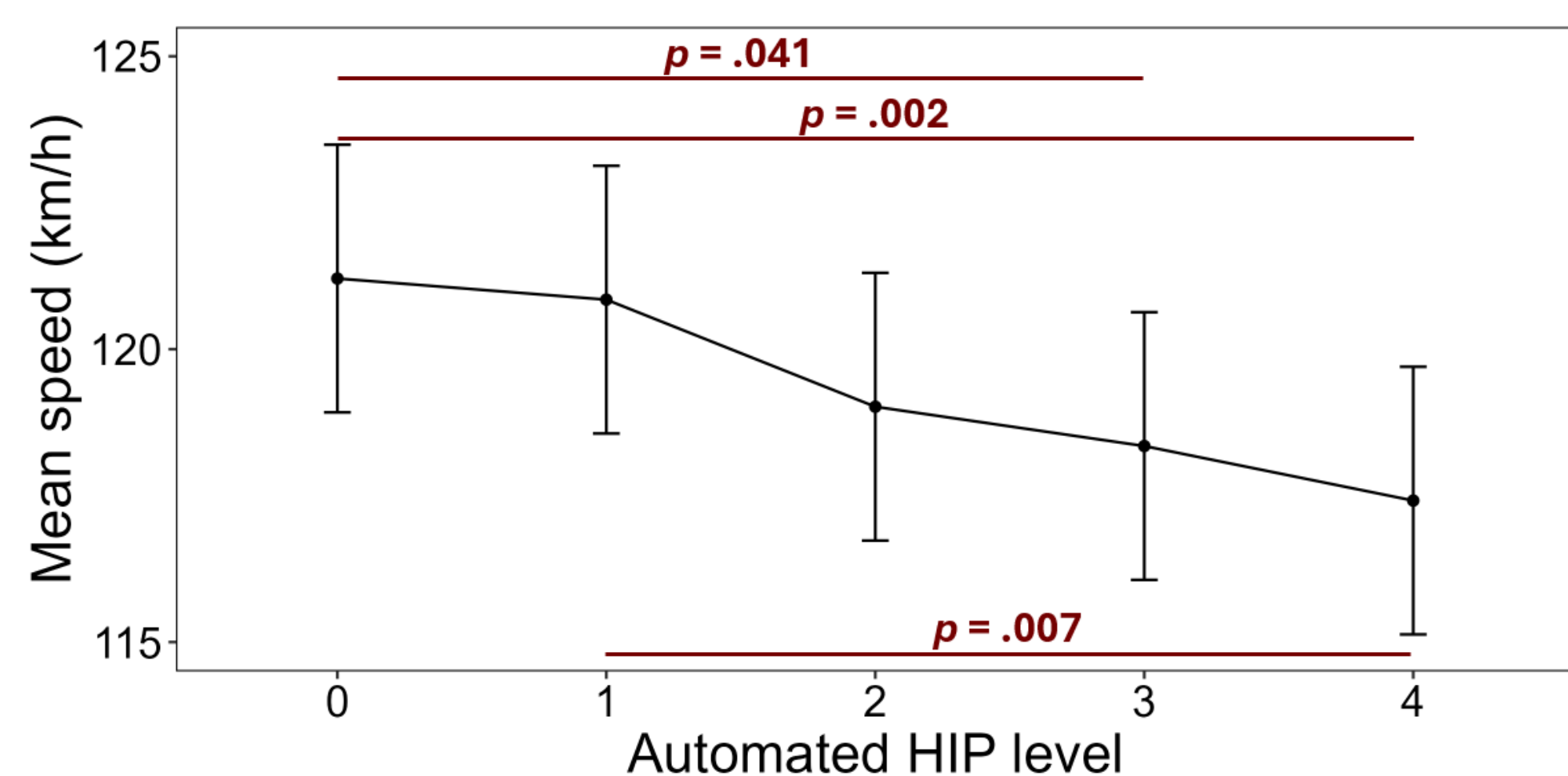


4. Action implementation



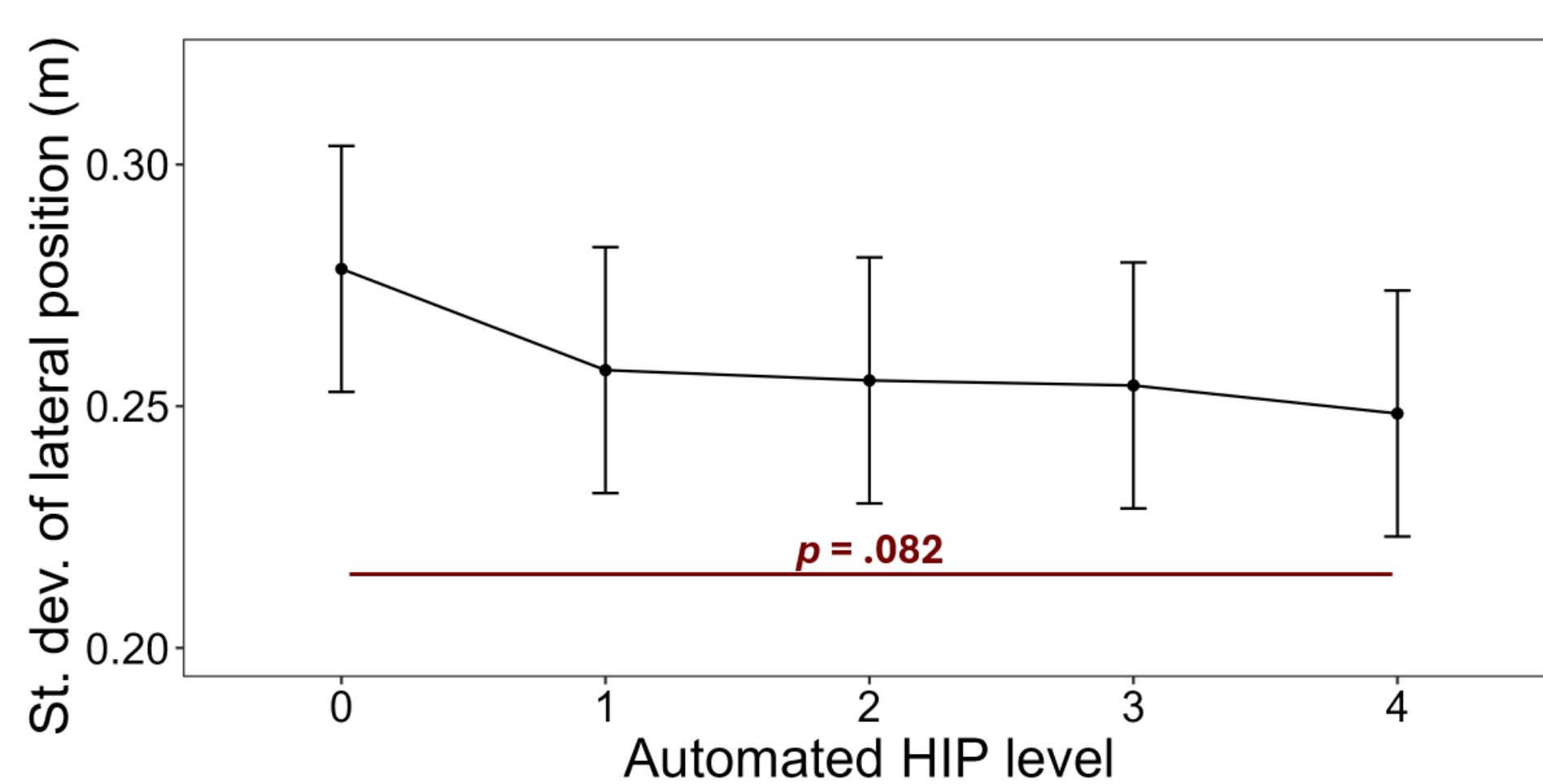
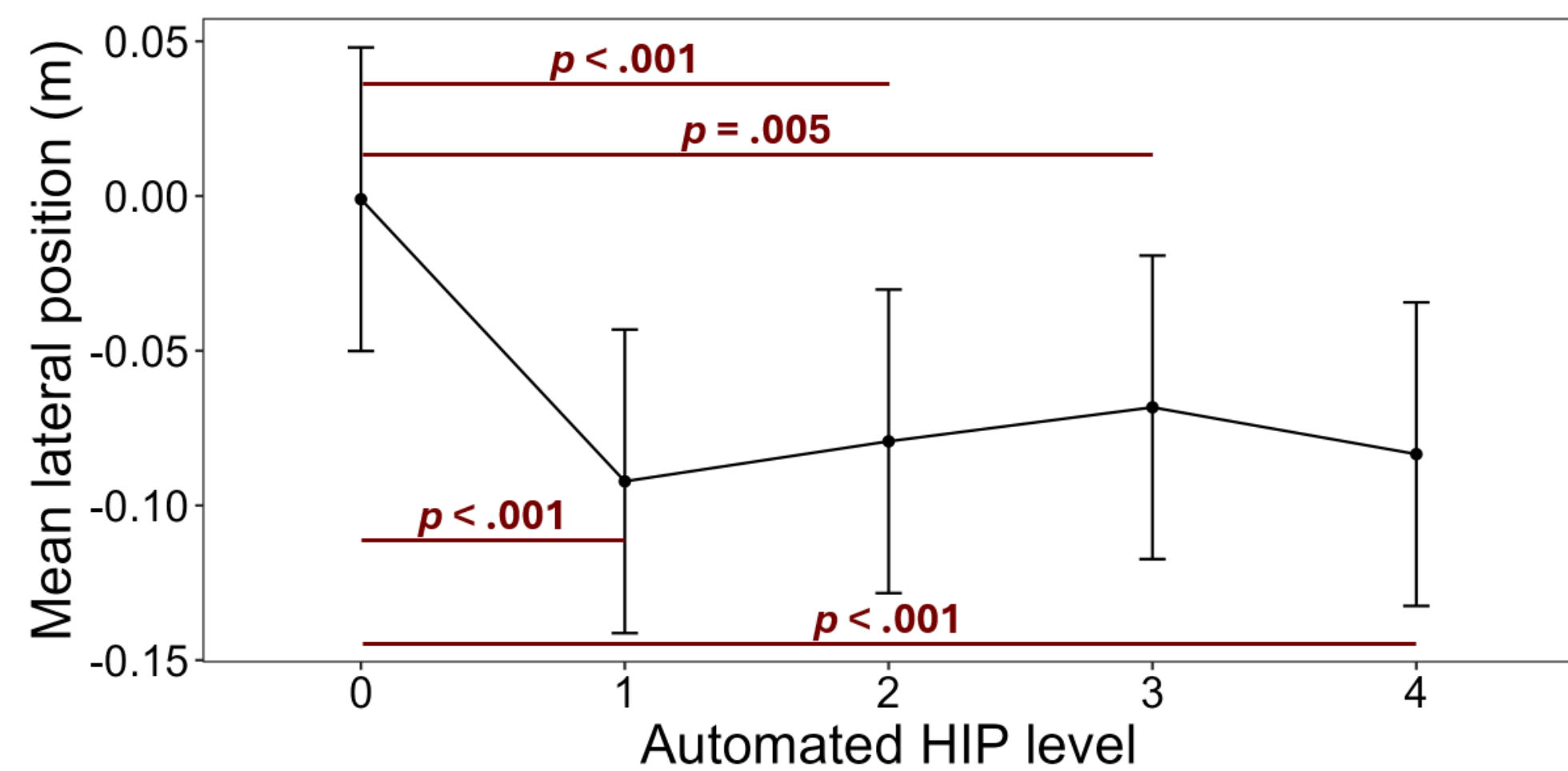
Results

Longitudinal behaviour



- Mean speed decreased at HIP 3-4, with the largest reduction at HIP 4, especially under LOS C.
- LOS C reduced speed and increased speed corrections compared with LOS A.
- HIP 4 increased speed variability, indicating more frequent speed adjustments.

Lateral behaviour



- HIP level significantly affected mean lateral position, indicating within-lane repositioning.
- Lateral variability showed limited changes across HIP levels.
- Lateral stability varied by gender and traffic conditions, with improved stability in males at HIP 1.

Key findings

- Adaptive automation influenced speed and lateral control, with effects depending on HIP level, traffic, and driver gender.
- HIP 3-4 were particularly beneficial for speed regulation, with greater effects under high traffic demand (LOS C).
- HIP 3 reduced speed corrections, suggesting more stable longitudinal behaviour.
- Lateral effects were limited, indicating greater benefits of adaptive automation for longitudinal than lateral control.
- Individual differences in responses highlight the need for personalised driver support.

Future research

- Assess the effects of system activation exposure (frequency and number of activations) under real-world conditions.
- Integrate gaze behaviour and mental workload to better understand drivers' responses to adaptive automation.

Essential references

- Kaber, D. B., Wright, M. C., Prinzel III, L. J., & Clamann, M. P. (2005). Adaptive automation of human-machine system information-processing functions. *Human factors*, 47(4), 730-741. <https://doi.org/10.1518/00187200577570989>
- Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, 30(3), 286-297. <https://doi.org/10.1109/3468.844354>