



Hands On, Eyes On!

Driver monitoring and behaviors in hands-free Level 2 automation

Linda Pipkorn¹, Pnina Gershon², Bruce Mehler², Bryan Reimer²

¹ Chalmers University of Technology, Gothenburg, Sweden

² MIT AgeLab, Massachusetts Institute of Technology, Cambridge, USA

Alert frequency

1.7 / h

hands-on-wheel alerts
95% CrI 1.0–2.8

0.9 / h

eyes-on-road alerts
95% CrI 0.4–2.0

Median response times

0.5 s

eyes back on road (median)
95% CrI 0.4–0.7 s

2.1 s

hands back on wheel (median)
95% CrI 1.8–2.5 s

1 · Background

Hands-free Level 2 systems are now widely deployed in the US. Using this feature shifts the driver's main task from continuous manual control to passive visual monitoring. This puts the design of driver monitoring and alerts at the centre of a driver support system. Controlled studies suggest reduced manual control may induce overreliance, but real-world use and response to alerts are understudied.

RQ1 How often do hands-on-wheel and eyes-on-road alerts occur per hour of highway driving?

RQ2 How do drivers respond to alerts – how fast do gaze and hands return?

RQ3 Is driving more hands-off associated with driving more eyes-off?

2 · Method

11

drivers (3 female),
mean age 45

167 h

naturalistic highway
driving

4 wk

with Ford
BlueCruise,
Mustang Mach-E

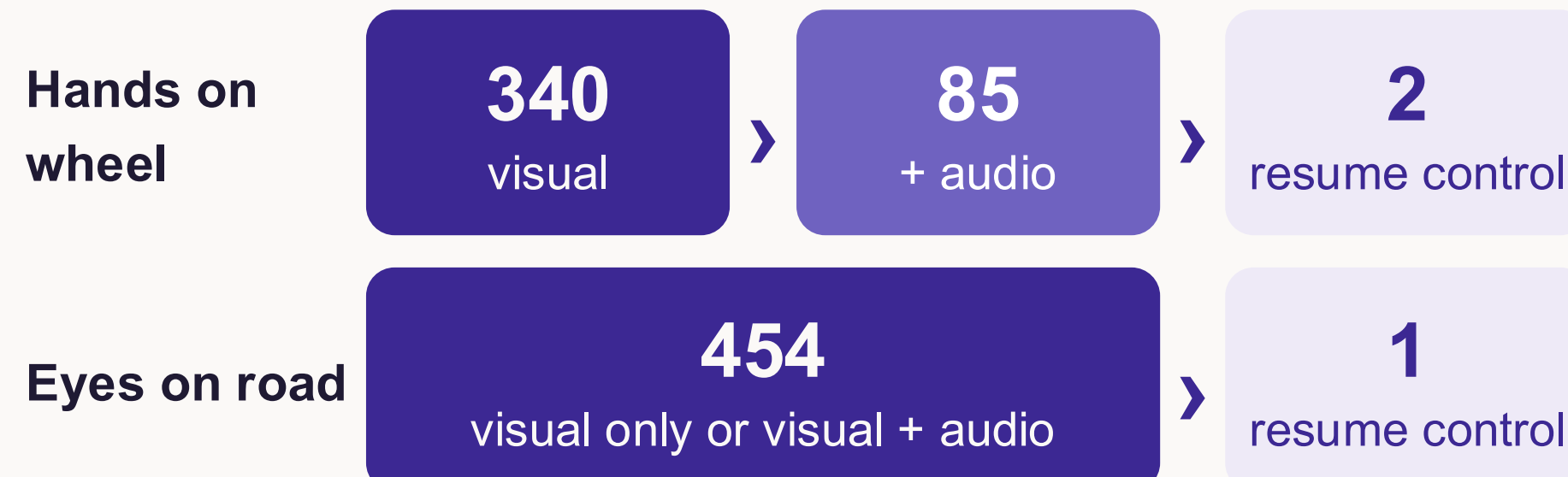
Data from the MIT Advanced Vehicle Technology study (New England, US) were collected in the Ford Mach-E with BlueCruise. Glance location and hands-on-wheel level were annotated from video of the driver, while driving mode and alerts came from video of the instrument cluster.



Fig. 1 Ford Mach-E instrument cluster in BlueCruise hands-free mode.

3 · Results

RQ1 · Alerts rarely escalate



Eyes-on-road alerts showed greater between-driver variability (log-rate SD 1.34 vs 0.74).

RQ2 · Eyes return fast, hands slower

Alerts did not always match observed behavior. Hands-on alerts coincided with hands off the wheel in 78% of cases (51–92%); eyes-on alerts with eyes off the road in only 38% (24–57%).

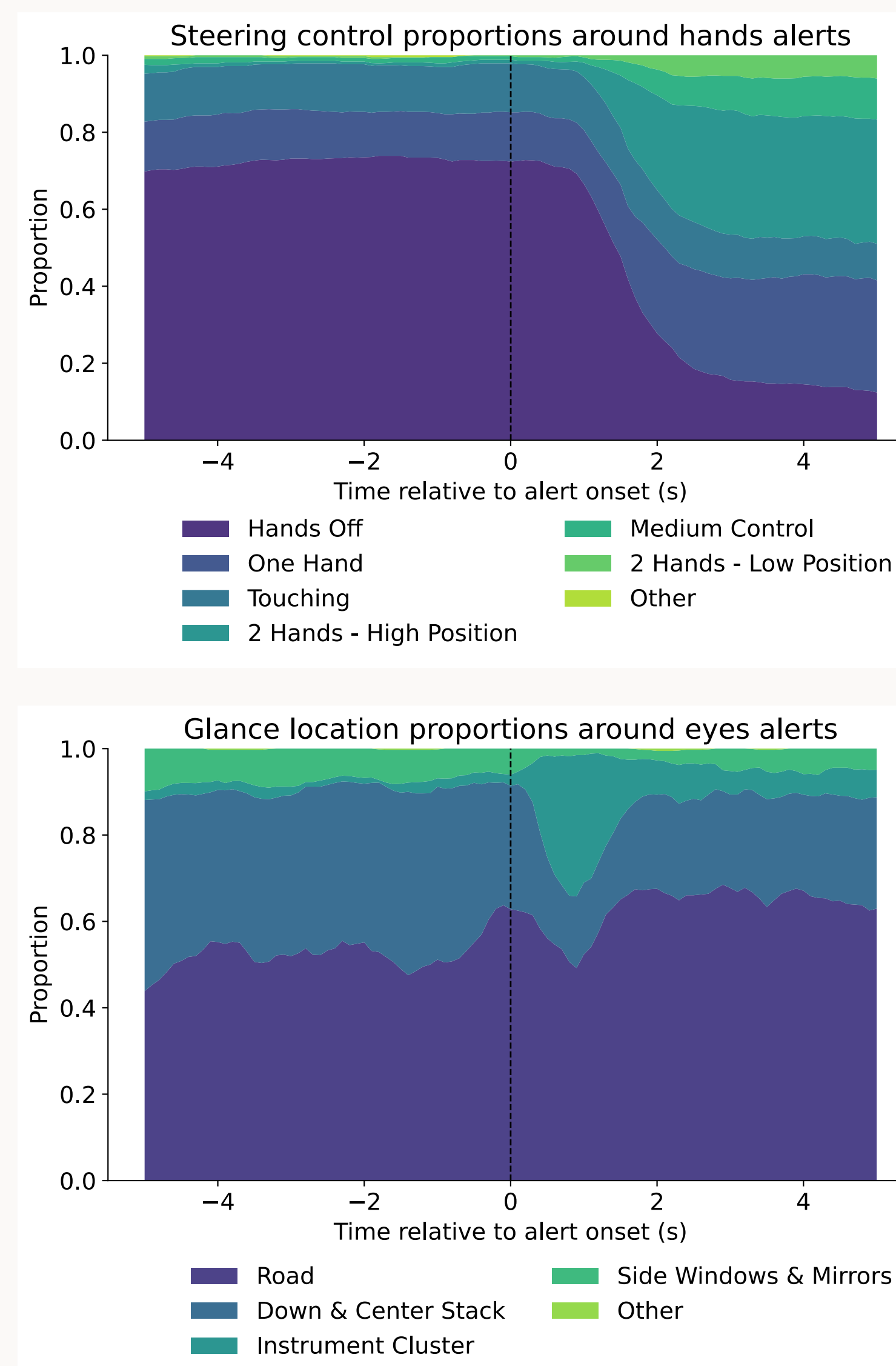


Fig. 2 Steering-wheel control (top) and glance location (bottom), 5 s around alert onset.

RQ3 · More hands-off, more eyes-off

Within hands-free segments, more hands-off time was linked to **longer maximum glances** down and to the centre stack, and to a **higher probability of eyes-on-road alerts**.

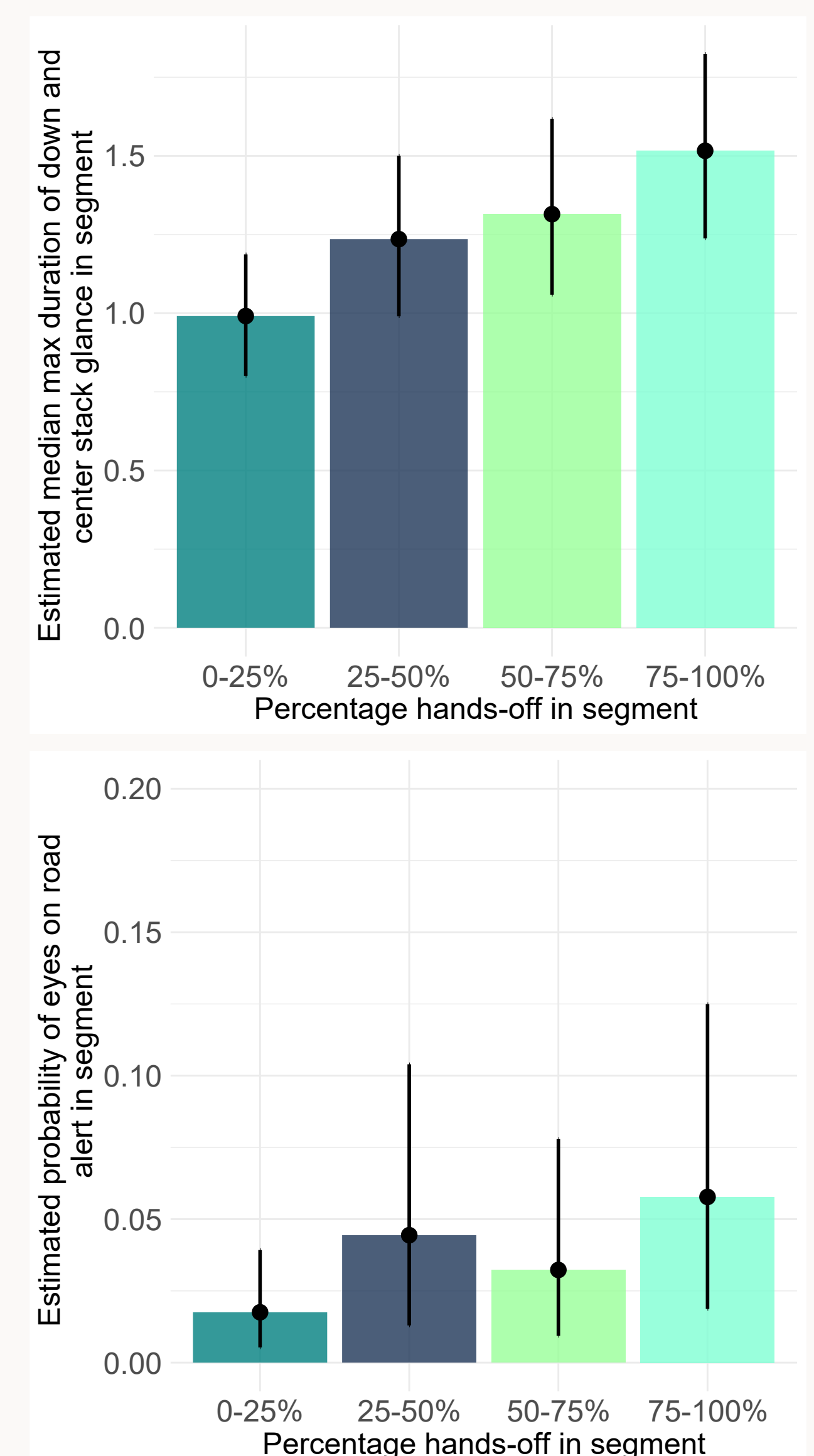


Fig. 3 Estimated medians and 95% CrIs eyes-off-road behavior by share of hands-off time in hands-free segments.

4 · Discussion

- Greater variability in eyes-on alerts may reflect that they depend mainly on driver behavior, whereas hands-on alerts also depend on road context, which could even out rates across drivers.
- Alerts prompted a brief instrument-cluster glance, likely to check the system state, before eyes returned to the road.
- More hands-off time came with longer glances down and to the centre stack. A possible link to non-driving tasks needs further study.

Take-home

2–3 alerts per hour

Drivers new to hands-free got ~1.7 hands-on and ~0.9 eyes-on alerts per hour. Alerts were a regular part of the experience.

Quick re-engagement

Drivers responded quickly to alerts, but many came when eyes were already on the road or hands on the wheel. Alerts that seem unnecessary may lose credibility.

Hands off, eyes off?

More hands-off time came with longer glances away from the road. Whether this means more non-driving tasks needs study.