Introduction

Drivers of automated vehicles must be able to detect and respond to automation failures, which requires maintaining attention to the roadway for prolonged periods of time.

Traditional vigilance tasks typically elicit a temporal decline in signal detection performance (Warm et al., 2015).

Declines in detection performance may lead to the driver not responding to automation failures and potential collisions (NHTSA, 2017).

The present findings warrant the need for additional research in order to further understand this phenomenon.

Purpose

To determine if a vigilance decrement occurs in drivers of automated vehicles who are tasked with detecting roadway hazards.

Apparatus

- STISIM Drive™ driving simulation software
- Logitech G27 steering wheel and pedals
- NASA TLX (Hart & Staveland, 1988) and Short Stress State Questionnaire change scores indicated a significant decrease in Engagement, F(9) = 3.96, p = .01, d = 1.25. Neither Worry nor Distress changed significantly, p > .05.

Procedure

- Participants (N = 11) “drove” a vehicle that automatically maintained 60 mph on a straight, one-lane road and maintained its position in the center of the lane.

- The majority (95%) of vehicles were stopped safely (i.e., not intruding into the main road), but 5% of the vehicles were stopped unsafely (i.e., intruding 1.25 feet into the main road).

- Participants were instructed to press a button mounted on the steering wheel upon seeing an unsafe-stopped vehicle (critical signal).


Results: Workload (NASA-TLX)

- A single-factor ANOVA revealed a significant main effect, F(2,96, 26.65) = 17.08, p < .001, η² = .46.

- Mean scores on NASA-TLX subscales of Mental Demand, Temporal Demand, Effort, and Frustration indicated substantial levels of workload (i.e., score > 50).


- Results: Risk Detection Performance

- Performance was evaluated with measures of percentage correct detections and percentage false alarms. The 40-minute drive was divided into four 10-minute periods of watch for analyses.

- Mean correct detections declined significantly across the vigil, F(2,40, 21.63) = 5.55, p = .006, η² = .38. Mean correct detections was significantly greater in period 1 than in period 4, p = .006.

- Mean false alarms did not differ significantly across the drive, p > .05.

- Conclusions

- Declines in mean correct detections indicate that the automated driving task induced a vigilance decrement.

- NASA-TLX scores indicate that the task induced high subjective workload and led to decreased task engagement, effects that characterize traditional vigilance tasks.

- Monitoring for potential roadway hazards over prolonged periods may result in a decline in detection performance, high workload, and disengagement which—in turn—may lead to collisions.

- The present findings warrant the need for additional research in order to further understand this phenomenon.

References