Research Report Summary

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Minimum Time to Situational Awareness During Transfer of Control Under Varying Levels of Task Load

Technology advancements in the previous two decades have made the human-vehicle connection stronger than ever. Since 2009, there has been a rapid development of advanced driver assistance systems (ADAS) as an increasing number of manufacturers have explored the immense potential in this area of AI. While the private sector continues to race forward with the development of autonomous features, there exists a need understand how human drivers will interface with these features before Level 5 automation can be achieved [1].

Research Objectives

- Examine whether minimum transfer of control time found in previous literature proves sufficient for drivers partaking in distracting, non-driving tasks
- Investigate whether the non-driving tasks diminish the drivers' abilities to take back control of the vehicle and perceive potential hazards

Scope and Design

Younger drivers (18-25) were the target demographic in this study, due to their distracted-driving susceptibility as well as potential higher trust in vehicle automation.

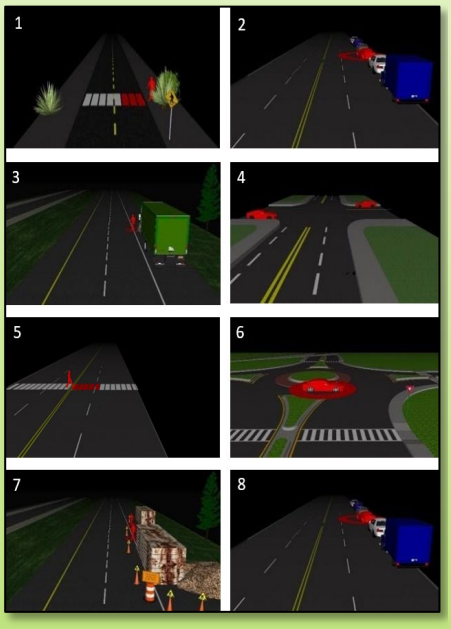
Driving Simulator Study

This study employed a within-subjects design with eight experimental hazard scenarios. Participants were instructed to engage in vehicle automation (visually and audibly), while partaking in one of the four tasks (active and passive). Participants were instructed to disengage vehicle automation 6 seconds ahead of a potential hazard (as depicted below).

Experimental Procedures

Active and passive tasks assigned to participants

#	Task Label	Description
1	Active – Visual Task	Playing solitaire on iPad
2	Passive – Visual Task	Reading on an iPad
3	Active – Auditory Task	Mock cell phone task
4	No Task	Control



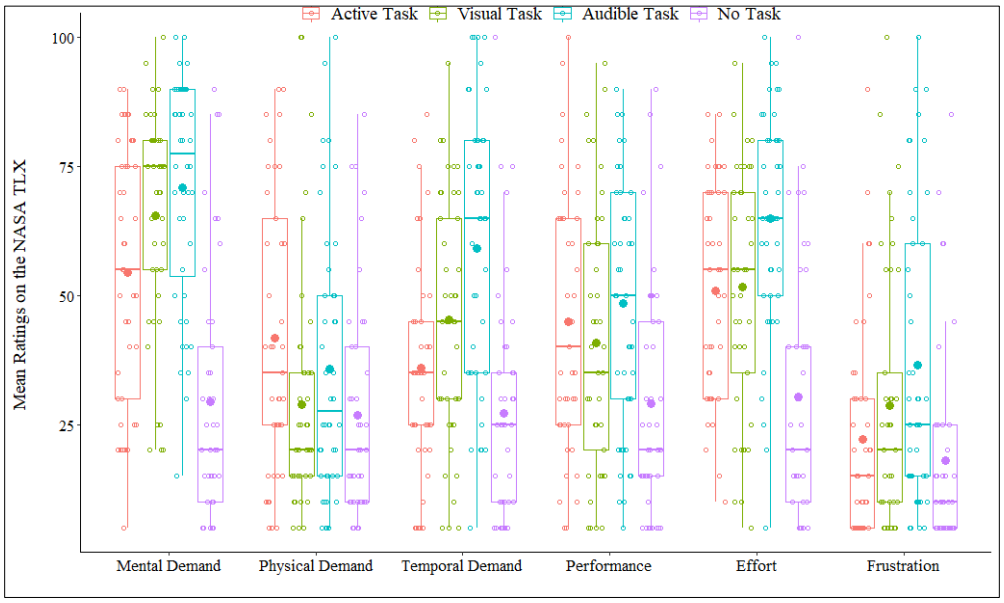
Visual schematics of the eight hazard scenarios

Summary of Findings

Driver glance behavior was tracked throughout the vehicle automation segment of each experimental drive. As hypothesized, the average off-road glance behavior was higher for the active visual task, as compared to the active auditory task.

Task Label	Description	Mean Off Road Glance Time (sec)
Active – Visual Task	Playing solitaire on iPad	51.2
Passive – Visual Task	Reading on an iPad	47.8
Active – Auditory Task	Mock cell phone task	16.2
No Task	Control	11.5

Participants were instructed to complete a NASA TLX questionnaire [2] following each experimental drive. Research findings present a significant task load increase across all non-driving tasks compared to the control. More so, the active auditory task yielded significantly higher task load scores across mental/temporal demand, effort, and frustration. This suggests that drivers generate an intriguingly higher cognitive demand while talking on a cell phone as compared to texting/reading while driving.



Metric	Mean (St. Dev.)			
	Active Task	Visual Task	Audible Task	No Task
Mental Demand	54.5* (24.8)	65.5* (21.7)	70.9* (21.8)	29.4 (24.3)
Physical Demand	41.7* (26.9)	28.8 (24.3)	37.8 (25.7)	26.8 (22.2)
Temporal Demand	35.9 (21.3)	45.2* (23.7)	59.2* (27.0)	27.2 (22.9)
Performance	45.0* (25.6)	40.9 (25.7)	48.4* (24.1)	29.0 (23.1)
Effort	50.9* (21.2)	51.7* (23.9)	64.9* (21.6)	30.2 (24.2)
Frustration	22.2 (20.6)	28.7 (25.1)	36.6* (28.3)	18.0 (19.6)

References

1. SAE. (2018). Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles. SAE International: Warrendale, PA, USA.
2. Hart, S. G. (2006). NASA-Task Load Index (NASA-TLX); 20 years later. In *Proceedings of the Human Factors and Ergonomics Society 50th Annual Meeting* (pp. 904-908), Santa Monica, CA.

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