

# Investigating Changes in Glance Allocation during Partially Automated Driving in Construction Zones



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# Automation Levels

- 6 levels
- Level 2 is responsible for accelerating, braking, and steering
- Driver must take control when necessary

## The 5 levels of driving automation

For on-road vehicles

		 Human driver	 Automated system		
		Steering and acceleration/deceleration	Monitoring of driving environment	Fallback when automation fails	Automated system is in control
Human driver monitors the road	<b>0</b> NO AUTOMATION				N/A
	<b>1</b> DRIVER ASSISTANCE				SOME DRIVING MODES
	<b>2</b> PARTIAL AUTOMATION				SOME DRIVING MODES
Automated driving system monitors the road	<b>3</b> CONDITIONAL AUTOMATION				SOME DRIVING MODES
	<b>4</b> HIGH AUTOMATION				SOME DRIVING MODES
	<b>5</b> FULL AUTOMATION				

# Problem

Switching  
from operator  
to supervisor

Driver  
disengaged  
when L2 is  
engaged<sup>1,2</sup>

Low cognitive  
workload due  
to boredom<sup>3,4</sup>

Drivers don't  
pay attention  
and focus on  
touchscreen<sup>5</sup>



Source: David von Diemar on Unsplash



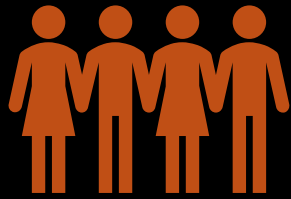
# Construction zones

- Construction zones involve lane changes, reduced visibility, traffic changes.
- National Safety Council noted 60% rise in construction zone fatalities since 2010<sup>6</sup>
- Studying how automation affects driver behavior in these zones is crucial.

# Research question

How does partially automated driving (Level 2) impact drivers' visual attention in construction zones?

# Methods



30 participants

12 females

Age 22, SD 4.36



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# Equipment





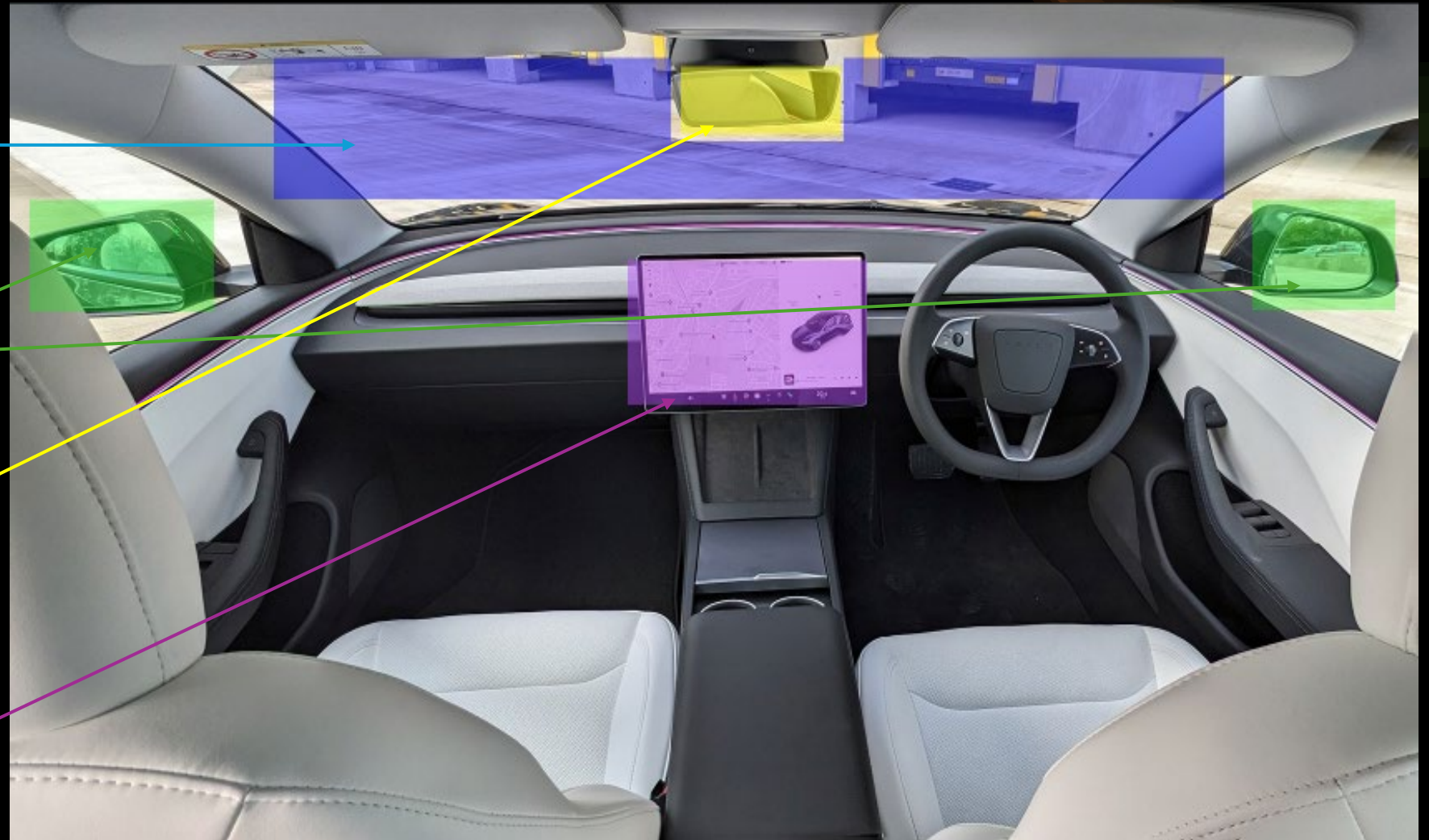
# Glance Coding

Front view

Side view mirrors


Rear view mirrors

Touchscreen



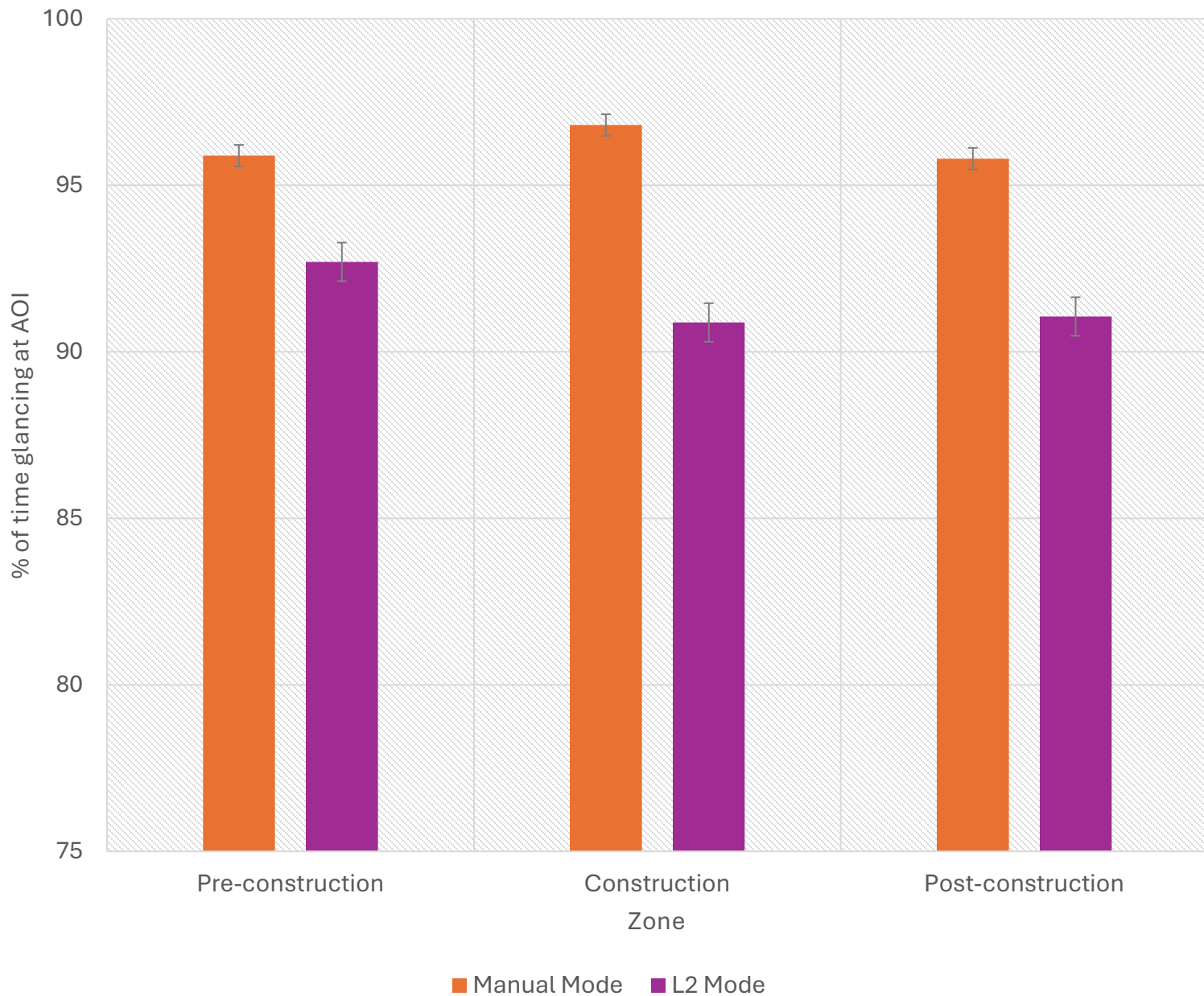
# Dependent Variable (Average % of time spent in each AOI)

$\% \text{ of time spent per AOI} = (\text{Time spent on AOI}) / (\text{Total time in zone}).$



E.g., 20s spent looking at the touchscreen during a 40s construction zone = 50%

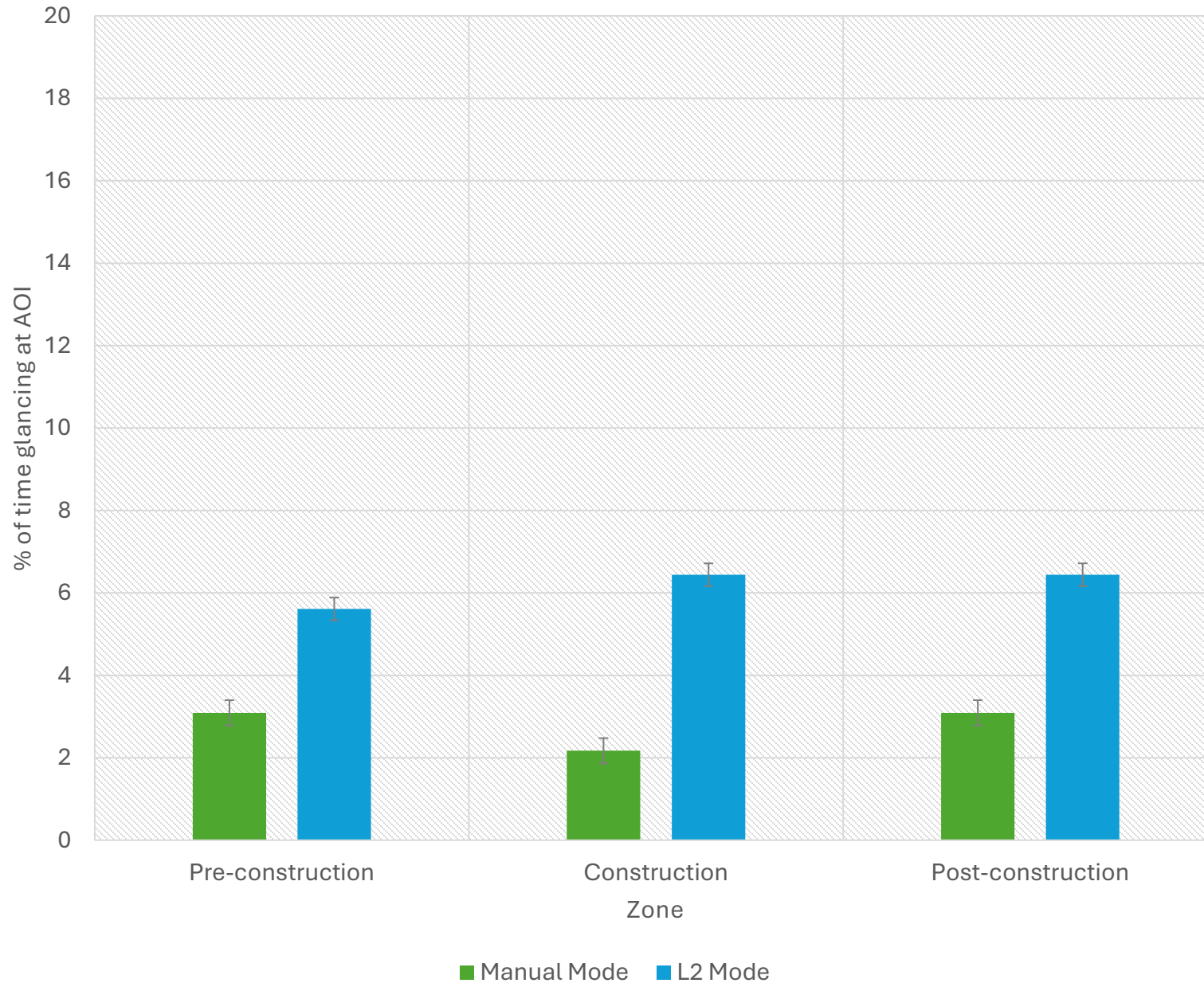
## Average % of Time Spent Looking at Front Road in Both Driving Modes



## Results

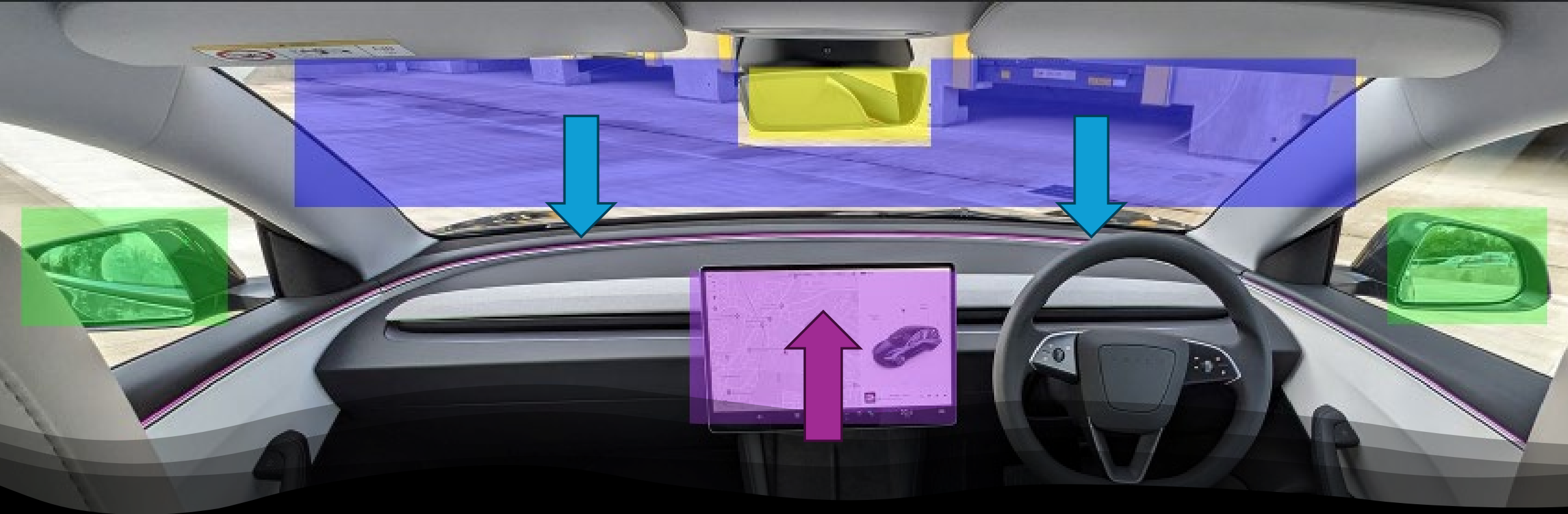
- Bayesian ANOVA
- IVs: Mode (2 levels), Zone (3 levels), and AOIs (4 levels).
- DV: average % of time spent in each AOI.

## Average % of Time Spent Looking at the Touchscreen in Both Driving Modes



## Results

- Bayesian ANOVA
- IVs: Mode (2 levels), Zone (3 levels), and AOIs (4 levels).
- DV: average % of time spent in each AOI.



## Conclusion

- When L2 was engaged, drivers spent less time looking at the front road and more on the touchscreen<sup>1,2,5</sup>
- This behavior persisted in construction zones, with no increase in front road glances.
- Overall, front road glances did not differ significantly between no construction and construction zones

# Acknowledgement

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# References

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Questions?



AOI	Driving Mode Effect (BF)	Construction Zone Effect (BF)	Interaction Effect (BF)	Meaning
Front road	5.4 x 10 <sup>3</sup>	0.08	96.13	Differences in driving modes; interaction matters.
Touchscreen	4.2 x 10 <sup>3</sup>	0.08	58.78	Differences in driving modes; interaction matters.
Side Mirrors	1.82	0.10	0.20	Weak evidence for driving mode effect
Rearview Mirrors	0.65	0.08	0.05	No effect from either factors.

# Construction Coding

- 3 construction sites
- 2 were removed
- Only 1<sup>st</sup> construction was analyzed



AOI	Manual driving (%)	L2 driving (%)
Eyes on the Road	96.8%	90.88%
Touchscreen	2.17%	6.44%

Average % of time during construction