

# The Effects of Vehicle Automation on Driver Engagement: The Case of Adaptive Cruise Control and Mind Wandering

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## Introduction

Adaptive Cruise Control (ACC):

- Maintains set speed.
- Maintains set following distance.
- ✓ Potential Benefits:
  - Reduced driver effort / workload.
  - Safer following distances.
- ✗ Potential Drawbacks:
  - Reduced driver alertness/arousal.
  - Increased mind wandering:
    - Reduced sensory input.
    - Faster driving speeds.
    - Shorter following distances.
    - Longer emergency response time.

## Research Question

What is the effect of ACC on driving performance, mind wandering, and driver arousal as measured by physiological activity?

## Method

**Participants:**

- 48 licensed drivers (44% female) from Washington DC metro area.

**Design:**

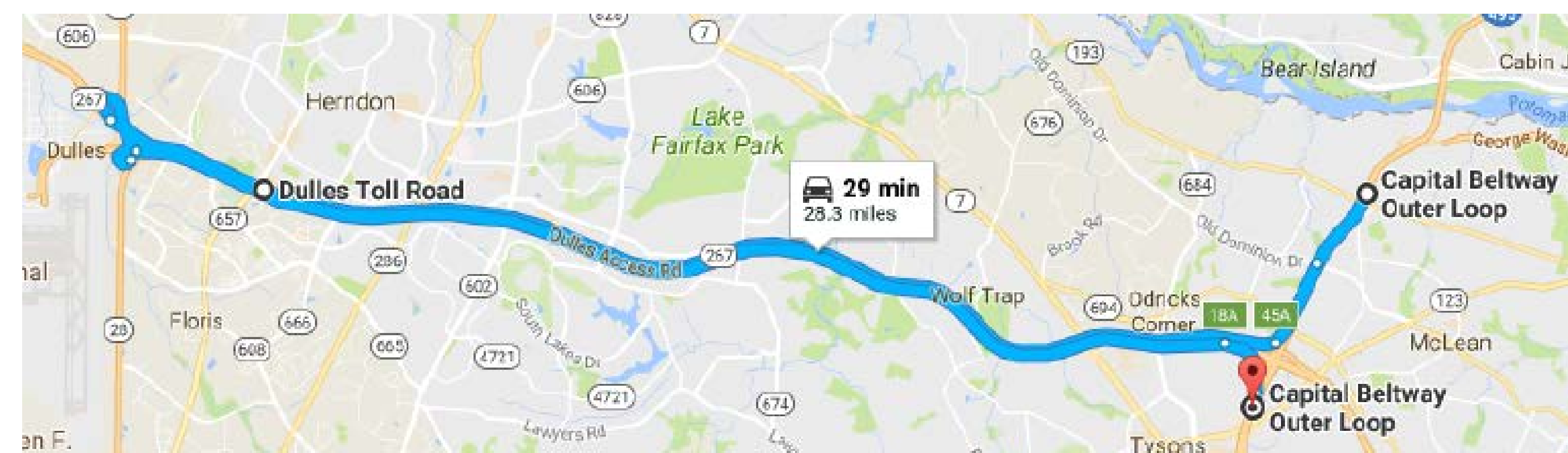
- ACC On / ACC Off.
  - All participants drove the route once with ACC on and once manually (ACC off).
- Lead Vehicle
  - Half of participants drove behind a lead vehicle; half drove without a lead vehicle.

## Acknowledgements

This work was funded by Federal Highway Administration Contract DTFH61-13-D-00024. Use of field research vehicle was provided by FHWA Saxton Transportation Operations Laboratory. Special thanks to Maddy Saraceno and Pascal Beuse for their data collection efforts.

## Route:

- 28.3 miles (approx. 30 mins), repeated twice per participant.



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## Field Research Vehicle:

- 2013 Cadillac SRX.
- Equipped with ACC.
- Instrumented to record data from vehicle CAN bus.



Source: FHWA

## Mind Wandering Assessment:

- Audio probes presented at random 90-150 s intervals
- Verbal Responses:
  - Driving (On Task): *If you were thinking about something related to driving. For example, if you were thinking about how fast you were going, about maintaining the appropriate distance from other vehicles, or about staying in the lane.*
  - Other (Mind Wandering): *If you were thinking about something other than driving. For example, if you were thinking about what you will eat for dinner, about a movie or TV show, or if you feel your mind was blank.*

## Physiological Recordings:

- Acquired from non-dominant hand:
  - Skin conductance responses (SCR) recorded from middle and right fingers.
  - Heart rate recorded from index finger.
  - Wireless transmitter worn on wrist.



Source: FHWA

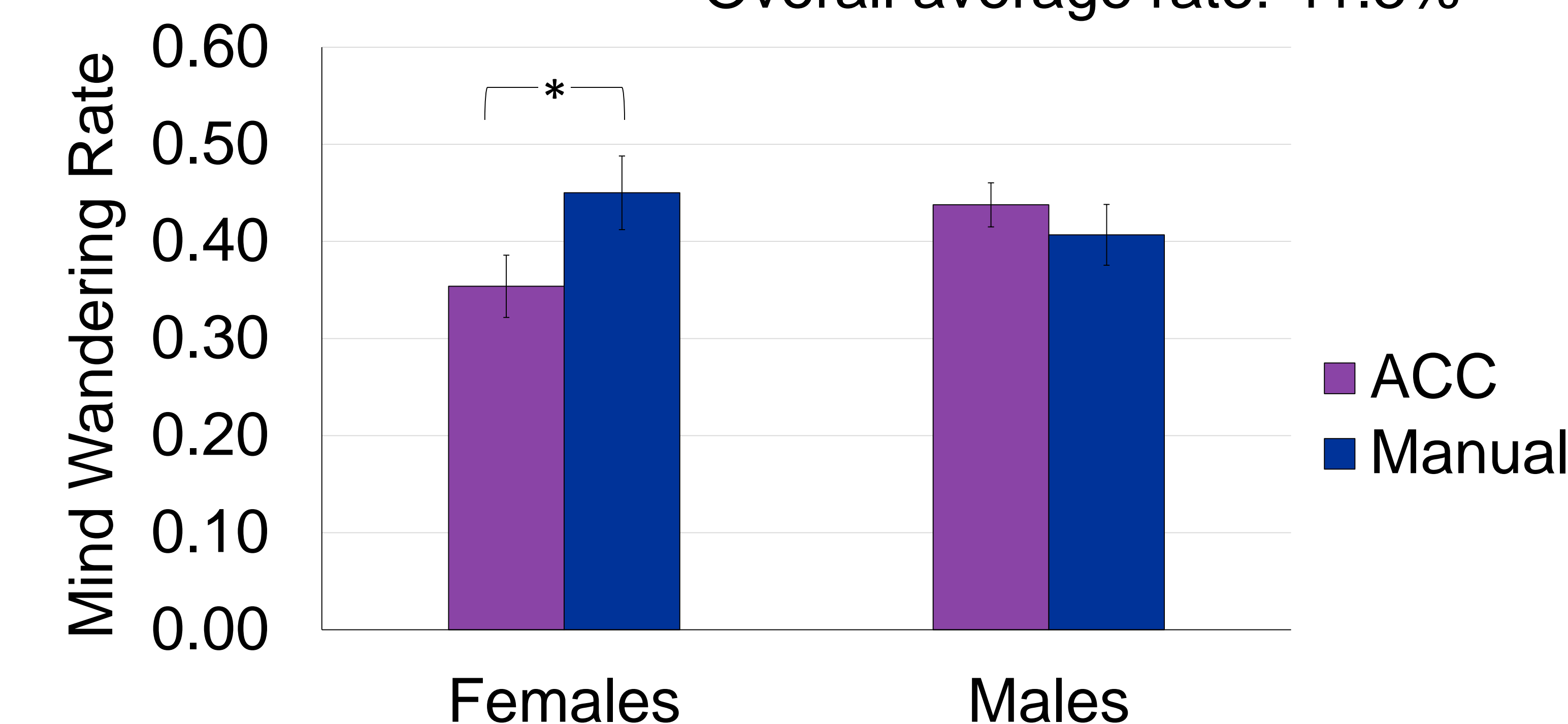
## Results

**Driving Performance:**

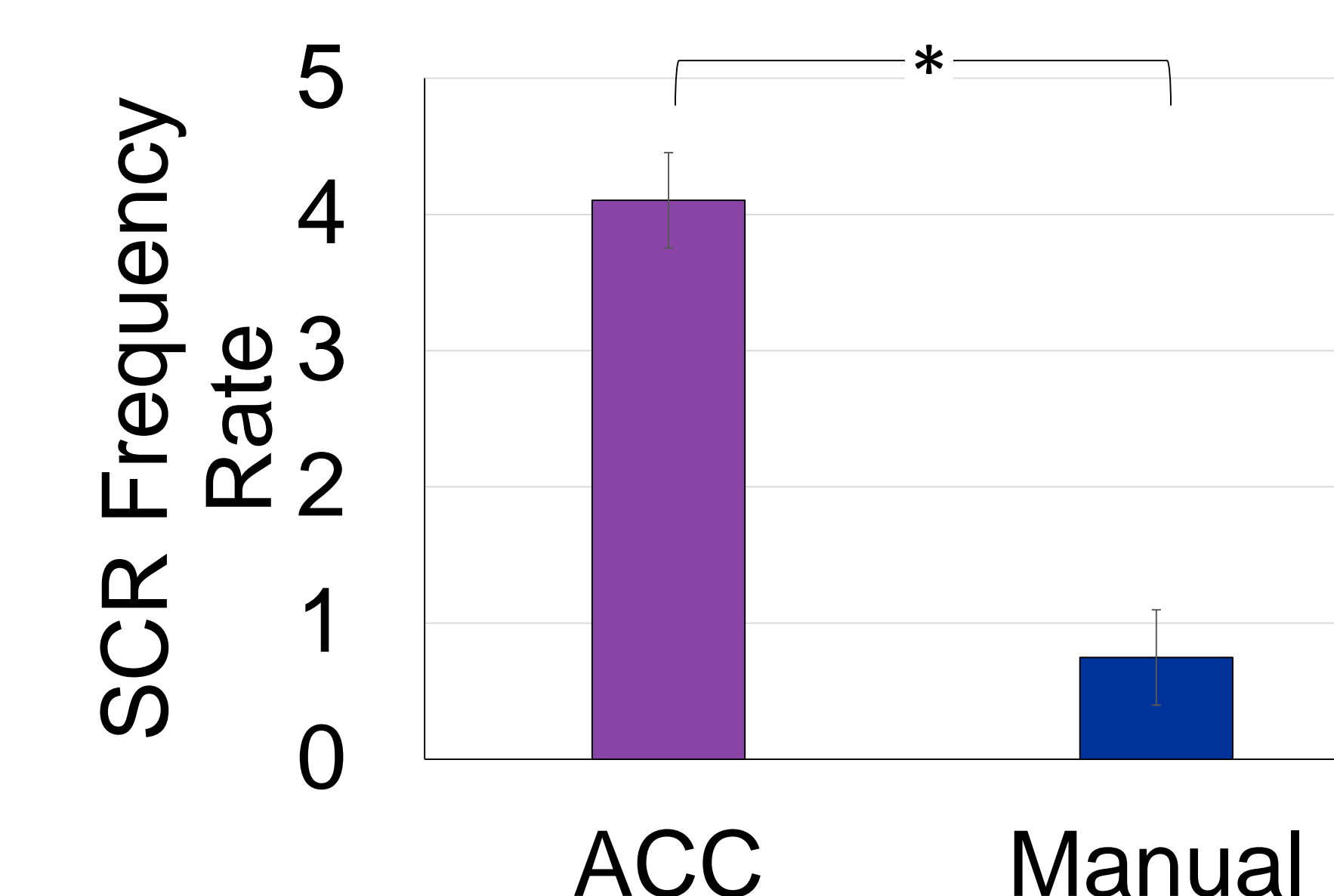
	ACC	Manual
Speed (w/o lead)	60.8 mph	62.2 mph
Steering Variability	5.3°	5.6°
Following Distance	146.5 meters	137.5 meters

**Mind Wandering:**

Overall average rate: 41.3%



**Physiological Activity:**



## Conclusion

Support for positive effects of ACC use on driver safety:

- Improved driving performance.
- No evidence of increased mind wandering.
- Increased physiological activity.

Limitations:

- 67% of participants very unfamiliar with ACC.
- Further research on long term effects of ACC is warranted.