

1. Background

- Driving depends on cognitive, perceptual, and motor abilities, which can be affected by cognitive decline.
- Brief clinical or on-road assessments may not fully capture how older adults drive in daily life.
- In-vehicle sensors can capture real-world driving behaviours over time.
- Identifying reliable digital driving markers may support earlier detection and monitoring of cognitive decline.

The purpose of this study is to quantify the associations between real-world driving measures and cognitive function.

2. Methods

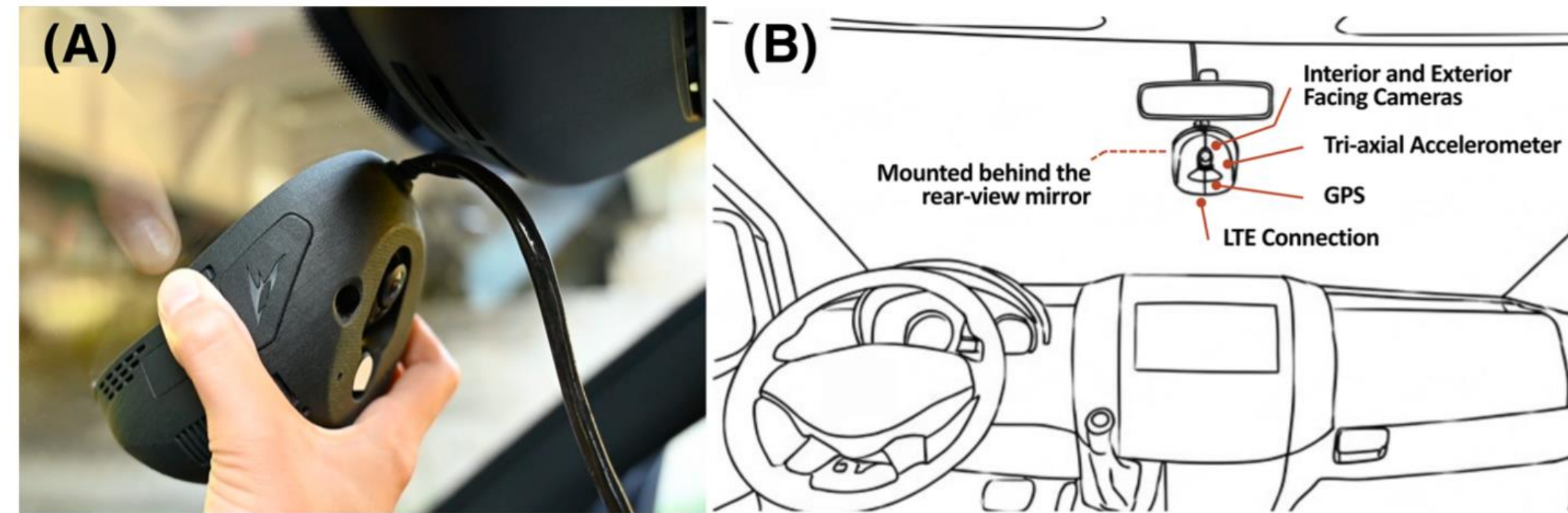


Fig 1. In-vehicle Driving Monitoring System

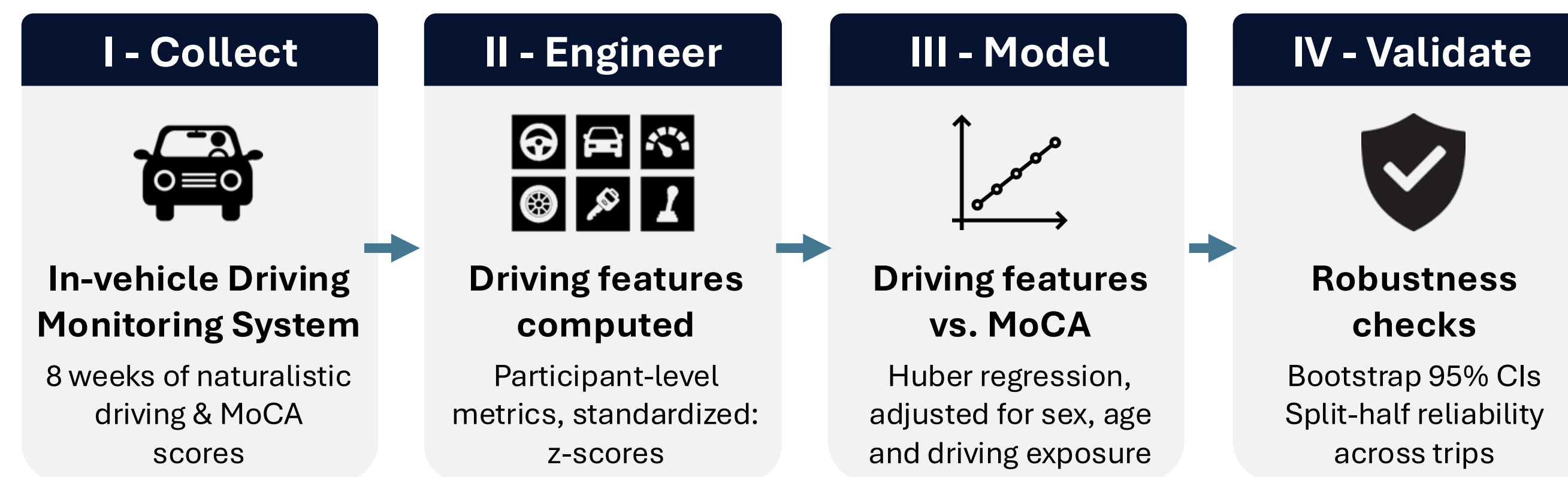


Table 1. Definitions and the units of the driving features calculated.

Feature	Unit	Definition
Mean speed (normal-speed zones)	km/h	Average vehicle speed on urban and arterial roads with posted limits of 40–70 km/h
Mean speed (high-speed zones)	km/h	Average vehicle speed on highways and other roadways with posted limits of 80–120 km/h
Mean lateral acceleration	g	Average magnitude of side-to-side acceleration
Under-speeding duration	s/trip	Average time per trip spent driving more than 10% below the posted speed limit
Speeding duration	s/trip	Average time per trip spent driving more than 10% above the posted speed limit
Harsh brake rate	events/100 km	Number of harsh braking events per 100 km driven
Mean speed during outlier turns	km/h	Average speed across turning maneuvers flagged as statistical outliers
Proportion of trip cruising	%	Fraction of trip time spent at relatively constant speed
Mean speed during tight/sharp turns	km/h	Average speed across tight, sharp-radius turning maneuvers

3. Results

3.1 Sample

Table 2. Average Demographics of All Participants

Site	Control n (Age: mean, range)	MCI n (Age: mean, range)
Calgary	14 (75.7, 66–88)	4 (72.5, 70–77)
Toronto	3 (72.7, 72–74)	7 (72.7, 70–76)

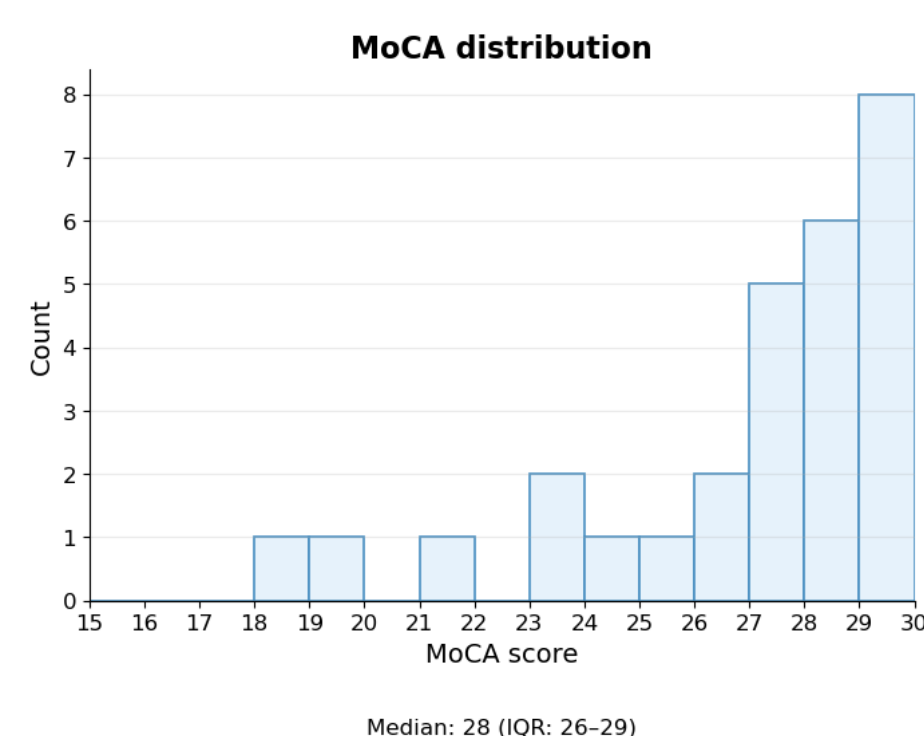


Fig 2. MoCA distribution (n=28)

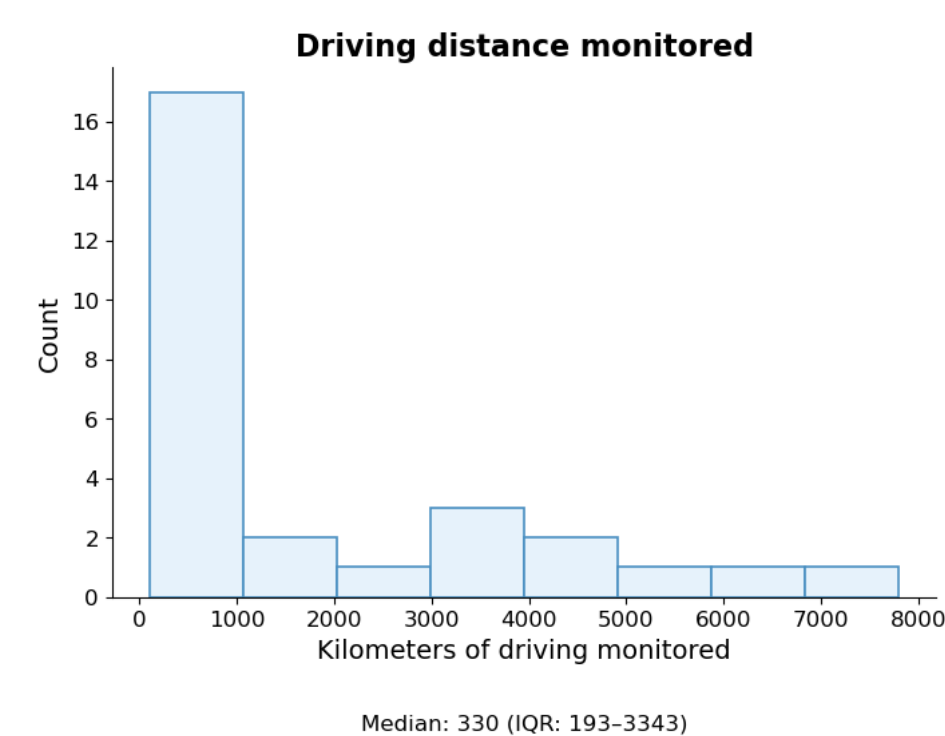


Fig 3. Driving distance distribution (n=28)

3.2 Main Findings

Associations between the top driving features and MoCA

Robust linear regression adjusted for age, sex, and driving exposure

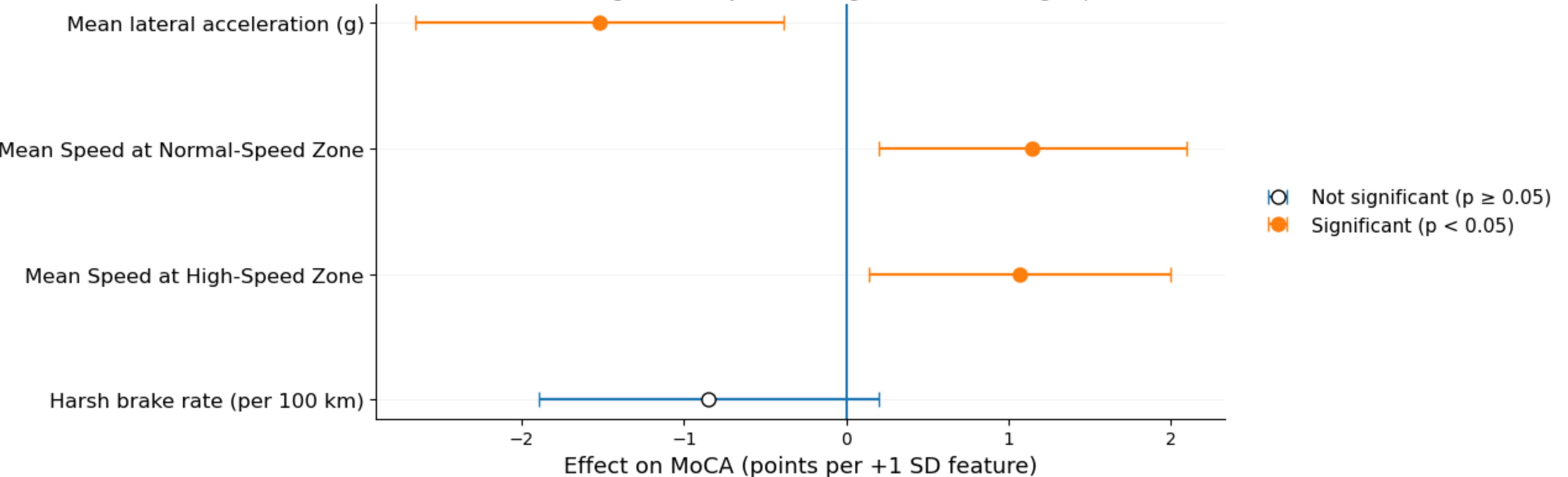


Fig 4. Associations between the top driving features and MoCA

(Note: “+1 SD” means a one standard deviation increase in the driving feature, or a higher-than-average value for that feature. The points show the estimated change in MoCA score associated with that increase.)

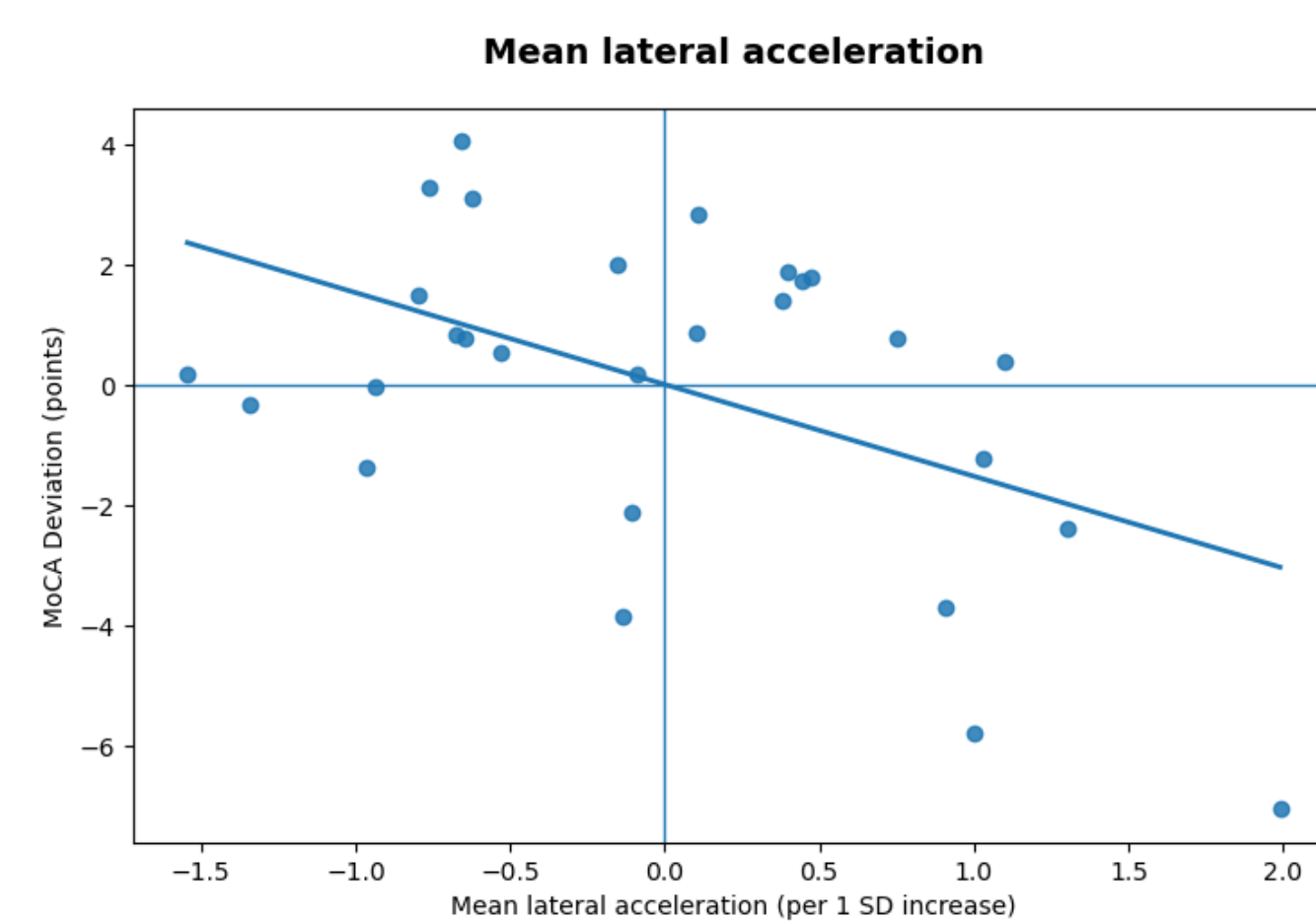


Fig 5. MoCA deviation versus mean lateral acceleration

(Note: For the driving features, 0 represents the sample average. Positive values represent higher-than-average values, and negative values represent lower-than-average values.)

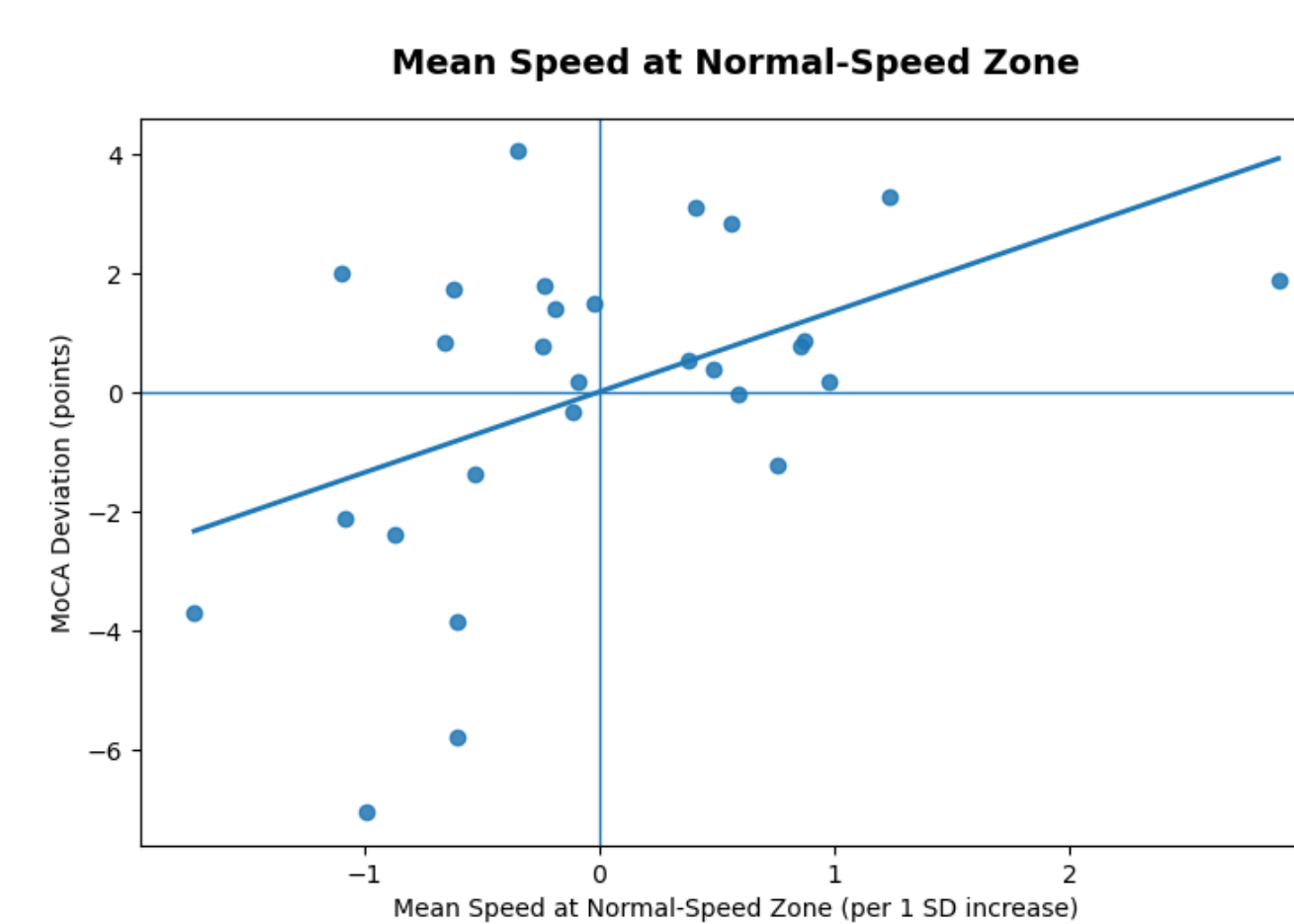


Fig 6. MoCA deviation versus mean speed at normal speed zone

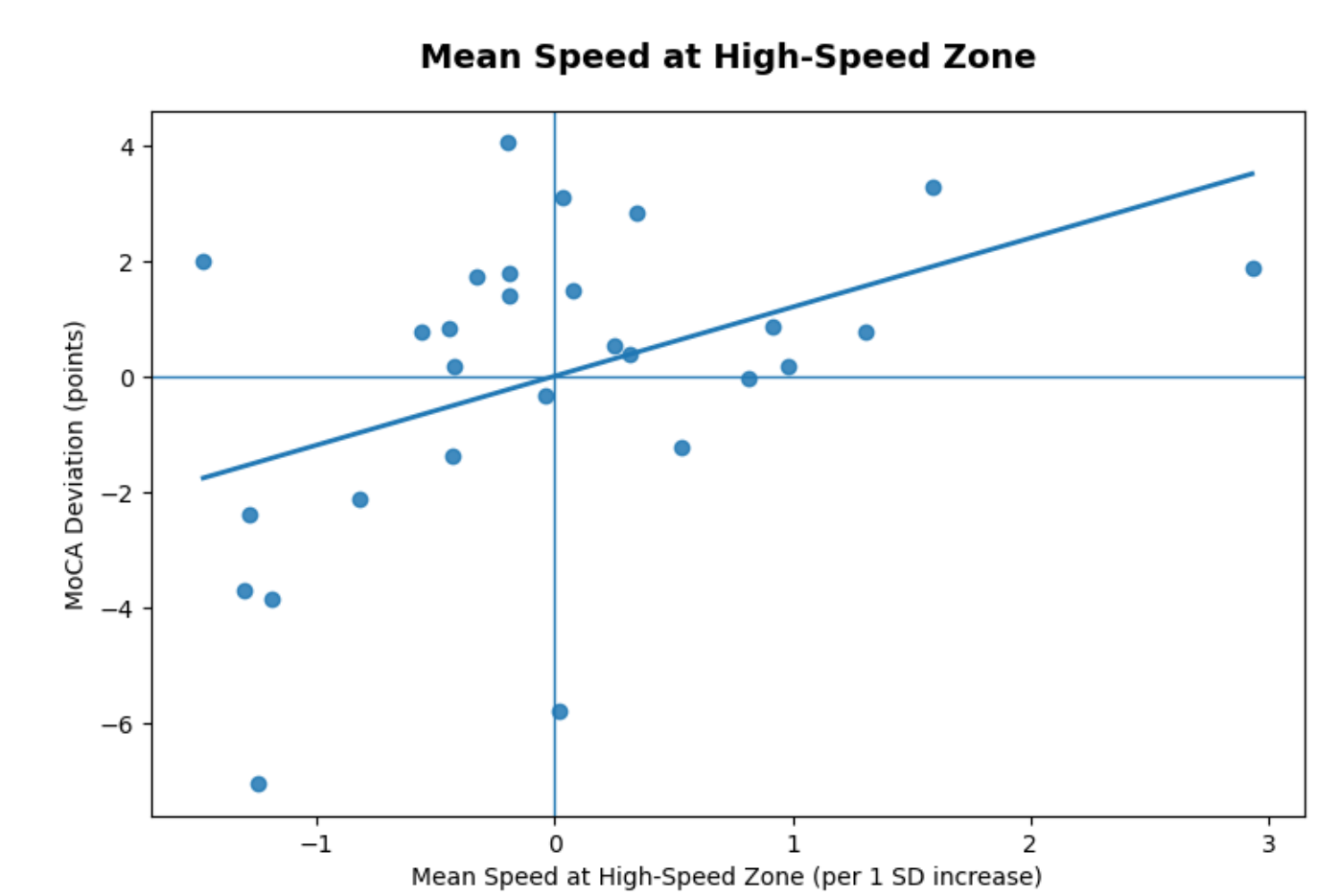


Fig 7. MoCA deviation versus mean speed at high-speed zone

Key Takeaways

- Lower MoCA scores were associated with
 - ✓ greater lateral acceleration,
 - ✓ lower average speeds on normal-speed roads, and
 - ✓ lower average speeds on high-speed roads.
- These findings suggest that naturalistic driving features may serve as candidate digital markers of cognitive function in older adults.
- Future research should include larger samples with similar numbers of healthy control and MCI participants and account for contextual factors such as road type and traffic.

Acknowledgements



Contact

