

Can a Driving Simulator Distinguish Between Cognitively Impaired and Healthy Older Drivers?

Fjolla Berbatovci¹, Neil Thomas^{1,2} Andrew Frank^{1,2}, Bruce Wallace^{1,3}, Shawn Marshall^{1,2}, Sylvain Gagnon⁴, Rafik Goubran^{1,3}, Frank Knoefel^{1,2,3}

¹Bruyère Health Research Institute, Ottawa, ON; ²Faculty of Medicine, University of Ottawa, ON; ³Systems & Computer Engineering, Carleton University, Ottawa, ON, ⁴School of Psychology, University of Ottawa, ON

BACKGROUND

- Cognitive decline is a risk factor among the elderly for motor vehicle crashes and fatalities. Assessment for individuals with mild cognitive impairment (MCI) is required.
- Ontario doctors are required to report patients with conditions affecting driving to Ministry of Transport.
- Current tools to assess driving risk are limited:
 - Cognitive screening tests (MOCA/MMSE, Trails A/B & clock-drawing tests)
 - Functional assessment: ADLs and IADLs
 - On-road testing: gold standard but costly, cannot simulate high-risk scenarios
 - Driving simulators: not yet used clinically, highly reproducible but simulator sickness

- OBJECTIVE: determine if a driving simulator can identify differences in driving behaviors in older drivers with MCI versus older drivers without cognitive conditions.

METHODS

- Participant cohorts
 - Patients living with MCI
 - Spouses of MCI Patients without cognitive conditions (Control)
- Virage VS500M-R driving simulator at Bruyère Health Research Institute
- Demographics questionnaire: driving experience and background
- Simulator sickness questionnaires (SSQs)
- MOCA screening test
- 8 driving modules
 - Practice: adaptation in highway
 - Non-driving tasks: simple reaction time, dual reaction time
 - Single driving tasks: crossing busy intersection, lane changes, pedestrian risk
 - Complex driving task: anticipation at intersections



FIGURE 1. Driving simulator located at Bruyère Health

RESULTS

TABLE 1a & b. Demographic data

a)

	Healthy		MCI		p-value
	n=9		n=12		
	mean	SD	mean	SD	
Age	72.8	4.27	74.8	7.16	0.3
Km/year	12,222	7546	10,500	6667	0.2
SSQ Score	16	12.7	24.6	23.1	0.2
NASA TLX Scores	48.1	24.2	51.7	31.2	

b)

	Healthy	MCI
Female (%)	55	46
University education (%)	100	92

TABLE 2. Completion of Simulator Modules

	Healthy	MCI
Completion of full battery (%)	56	75

*2 MCI participants could not complete the modules due to motion sickness. 1 control participant dropped out due to lack of interest.

ACKNOWLEDGEMENTS

Special thanks to our participants. F. Knoefel acknowledges the support for the Bruyère Health Research Institute Chair in Research in Technology for Aging in Place

TABLE 3. Simulator Driving Data

	Healthy	MCI	p-value
	n=9	n=12	
Single Task Time Brake (mean, s)	0.63	0.72	0.05*
Dual Task Time Brake (mean, s)	0.85	1.05	0.02*
% Safe Crossing	91.4	82.5	0.24
% Crashes	0	7.5	0.09
% Near Crashes	5.71	0	0.15
Deviation from lane (>0.5m)	4.25	8.14	0.047*

Analysis of the simulator results was able to identify differences in driving skills between older drivers with MCI from older drivers without cognitive conditions.

- MCI reaction times were slower in both single and dual tasks – expected
- MCI had lower % safe crossing and higher % crashes – expected
- MCI had more lane deviations – expected

More data and variables are needed to better understand the potential use of the simulator as a clinical adjunct.

FUTURE DIRECTIONS

Next steps:

- Continue recruitment to strengthen the statistical analysis (15 in each group)
- reduce simulator sickness and increase completion rates especially among the control participants to ensure the most reliable comparison between the two groups.
- develop cut-off values for safe driving, to prepare for simulator use as a clinical tool in the future



uOttawa



Santé Bruyère
Institut de recherche

Bruyère Health
Research Institute



INNOVATION
Canada Foundation
for Innovation
Fondation canadienne
pour l'innovation

Carleton
University



VIRAGE
SIMULATION