Exploring the capacity of neurological and neuropsychological measures to predict driving performance in individuals with MCI

I. N. Beratis[1], A. Economou[2], D. Pavlou[3], N. Andronas[2], G. Yannis[3], S. G. Papageorgiou[1]

[1]2nd University Department of Neurology, "Attikon" University General Hospital & [2]Department of Psychology, University of Athens,
[3]Department of Transportation Planning & Engineering, National Technical University of Athens

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Abstract

Introduction: The driving capacity of individuals with Mild Cognitive Impairment (MCI) is an open issue.

Objective: The present research aimed at exploring the capacity of neurological and neuropsychological measures to predict driving performance in individuals with MCI

Methods: A CDR score of 0.5 was required for the diagnosis of MCI. Additional inclusion criteria were the presence of a valid driver's license and regular car driving.

Results: Measures assessing information processing speed, visuospatial memory, balance and movement coordination and psychomotor vigilance played an important role on predicting driving indexes, such as number of crashes, reaction time, average driving speed and lateral position variation

Conclusion: The present findings show that neurological and neuropsychological measures are useful predictors of driving competence of individuals with MCI and could be used for detecting MCI patients at risk for car accidents.

Background

- The number of drivers in Europe and North America that are older than 65 is constantly increasing (Yannis et al., 2011)
- Elderly individuals keep their driving license longer and drive larger distances. However, the percentage of older drivers that are at risk due to cognitive or physical impairments remains unknown
- MCI population appears to be at risk for driving difficulties, although their performance on on-road or on simulator testing is not consistently worse than that of controls (Fritteli et al., 2009; Kawano et al., 2012; Wadley et al., 2009)
- Measures of mental flexibility, inhibitory control and visual attention appear to be associated with driving performance in patients with MCI, but this issue needs further investigation (Kawano et al., 2012)

Objective

Scope of the present research was to explore in individuals with MCI the capacity of neurological and neuropsychological measures to predict various indexes of driving performance, namely: number of crashes, reaction time, average driving speed, lateral position variation, and average headway time

Methods

- A CDR (Clinical Dementia Rating) score of 0.5 was required for the diagnosis of MCI. Additional inclusion criteria were the presence of a valid driver's license and regular car driving
- The sample of the present study was comprised of 16 individuals with MCI and 14 cognitively intact individuals of similar age and educational level. The collection of the data included: (a) a clinical medical and neurological assessment, (b) extensive neuropsychological assessment that included two different sessions taking place in different days(≈2 month interval), and (c) a driving simulation experiment
- Driving was assessed with a Foerst FPF driving simulator, in different conditions

I. Phase 1: Practice session (5-10 min.)

II. Phase 2: Driving session: driving on a two-lane rural road for 20 min. The sudden appearance of animals on the rural road played the role of unexpected incidents during the driving assessment

Figure. 1 Driving under the rural Condition

Results

Table.1 MCI vs Control Group on Driving Indexes

	MCI		Control Group		t-test	
	Mean	SD	Mean	SD	t	p
Average Speed	42.24	7.46	43.62	7.33	.51	.61
Reaction Time (sec)	1.89	.46	1.78	.28	.80	.43
No. of Crashes	.56	.81	.43	.65	.49	.63
Lateral Position Var.	.27	.42	. 28	.46	.37	.72
Headway Time	41.11	19.55	38.40	22.41	.36	.73

AVERAGE SPEED

1) MCI group: R^2=.559, F(2,13)=8.25, p=.005.
Predictors: (1st level) cognitive functioning (MMSE) (2nd level) balance and movement coordination (Tandem Walking, β=-.63, p=.007)
2) Control group: R^2=.166, F(2,11)=1.10, p=.368

REACTION TIME

1) MCI group: R^2 =.732, F(3,12)=10.92, p=.001
Predictors: (1st level) cognitive functioning (MMSE) (2nd level) information processing speed (SDMT, β=-.60, p=.014), balance and movement coordination (TandemWalking_RNC,β=.54, p=.007)
2) Control group: R^2=.119, F(3,10)=.45, p=.772

NUMBER OF CRASHES

1) MCI group: R^2=.773, F(3,10)=11.35, p=.001
Predictors:(1st level) cognitive functioning (MMSE) (2nd level) visuospatial memory (BVMT_Recognition, β=-.40, p=.056), speed of attention (UFV_1, β=.48, p=.027)
2) Control group: R^2=.279, F(3,10)=1.29, p=.330

VARIATION OF LATERAL POSITION

1) MCI group: R^2 =.470, F(2,11)=4.17, p=.031
Predictors:(1st level) cognitive functioning (MMSE) (2nd level) psychomotor vigilance (β=.67, p=.014)
2) Control group: R^2=.387, F(2,11)=3.47, p=.068

HEADWAY AVERAGE TIME

1) MCI group: R^2=.372, F(2,13)=3.86, p=.048.
Predictors: (1st level) cognitive functioning (MMSE) (2nd level) balance and movement coordination (Tandem Walking, β=-.62, p=.020)
2) Control group: R^2=.178, F(2,11)=1.191, p=.340

Summary

- The findings show that neurological and neuropsychological measures are useful predictors of driving performance indexes in individuals with MCI
- In the cognitively intact group the same predictors were not contributing to the prediction of driving performance
- Measures assessing balance and movement coordination, visuospatial memory, speed of attention, psychomotor vigilance and information processing speed made the most important contribution on predicting various indexes of driving performance in the MCI group
- The best prediction of certain driving indexes was achieved by a combination of neuropsychological and neurological measures
- Next steps: (a) evaluation of additional driving indexes as well as inclusion of additional driving conditions (e.g. urban streets with multiple lanes, distraction); (b) application of on road driving evaluations

References/Acknowledgments

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