

# CAN BRIEF NEUROPSYCHOLOGICAL TESTS PREDICT THE DRIVING BEHAVIOR OF PATIENTS WITH PARKINSON'S DISEASE (PD)?

Z.Karagkiolidou<sup>1</sup>, I.N.Beratis<sup>1</sup>, D.Pavlou<sup>2</sup>, N.Andronas<sup>1</sup>, D.Kontaxopoulou<sup>1</sup>, S.Fragkiadaki<sup>1</sup>, G.Yannis<sup>2</sup>, L.Stefanis<sup>1</sup>, S.G.Papageorgiou<sup>1</sup>



<sup>1</sup> 2nd Department of Neurology, "Attikon" University General Hospital, University of Athens,

<sup>2</sup> National Technical University of Athens, School of Civil Engineering, Department of Transportation Planning and Engineering, Athens, Greece

1<sup>st</sup> Panhellenic Congress on Neuropsychology, Athens, Greece, April 27-29, 2018

## ABSTRACT

**OBJECTIVE:** Goal of the present research was to explore the predictive value of brief neuropsychological tests in driving behavior of PD individuals under low and high traffic conditions on a rural driving environment. **METHODS:** Nineteen PD individuals (Age:63±11,1years) and forty-two cognitively intact individuals (Age:59,5±8,7years) participated in the study. Participants completed neuropsychological measures, including Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), Clock Drawing Test (CDT), Frontal Assessment Battery (FAB), Trail Making Test- Trails A & B (TMT A & B), assessing general cognitive ability and executive functions. All individuals underwent a driving simulator experiment, where parameters of driving behavior were measured: average speed, lateral position, average reaction time and headway distance. **RESULTS:** By applying t-test for independent samples, significant differences were found between PD patients and the control group in average speed (p<0,01) and in average reaction time (p=0,002) under high traffic conditions on rural road. A regression model using PD individuals, with the neuropsychological tests as predictors, explained 38% of the variance in headway distance under high traffic conditions and thus identified the predictive value of CDT, TMT A and TMT B. **CONCLUSION:** The results of the present study indicate that the driving behavior of PD individuals differed significantly from those of healthy individuals. Neuropsychological tests may have a predictive value. Future studies should include a larger sample size and additional assessments of executive functions.

## INTRODUCTION

- Driving is a multi-domain task that engages various aspects of cognition and motor functioning.
- Parkinson's Disease not only impairs one's ability but also cognitive skills, especially executive functions (Bott et al., 2014. Chan et al., 2018).
- These motor and cognitive symptoms have an impact on driving performance in many ways (Rancet et al., 2011. Beratis et al.,2015. Pavlou et al.,2016).

## OBJECTIVE

Goal of the present research was to explore the predictive value of brief neuropsychological tests in driving behavior of PD individuals under low and high traffic conditions on a rural driving environment.

## METHODS

- The participants had a valid driver's license, car driving on a regular basis, a Clinical Dementia Rating (CDR) score ≤ 0.5 and between 1 and 3 in the scale of Hoehn & Yahr.
- Nineteen PD individuals (Age:63±11,1years) and forty-two cognitively intact individuals (Age:59,5±8,7years) participated in the study.
- Patients with PD were all in the ON state
- Participants completed a series of brief **neuropsychological tests**, assessing general cognitive ability and executive functions.
- All individuals underwent a driving simulator experiment, where parameters of driving behavior were measured:  
**average speed** (AS- km/h),  
**lateral position** (LP- average vehicle distance from the central road axis in meters),  
**average reaction time** (RT- in milliseconds) and  
**headway distance** (HD- average distance from other vehicles in meters).
- Driving was assessed with a Foerst FPF driving simulator, including a practise session (5-10 min.) and a 20- minute driving session (driving on a two-lane rural road, under low and high traffic conditions).

## RESULTS

Table 1- Control vs. PD group on Driving Parameters

Driving Parameters	PD group		Control group		T-test		
	Mean	SD	Mean	SD	t	p	
Low traffic conditions	AS	41,00	10.52	46,23	6.98	1,97	0,05
	LP	1,44	.11	1,46	.13	0,58	0,564
	RT	1788,08	572.46	1605,23	427.34	-1,24	0,224
	HD	1967,29	259.82	2096,32	160.22	1,99	0,057
High traffic conditions	AS	35,82	7.24	43,71	5.8	4,52	<0,01*
	LP	1,57	.12	1,58	.15	0,37	0,713
	RT	2215,97	732.94	1623,56	621.38	-3,24	0,002*
	HD	2114,25	208.47	2047,90	136.98	-1,47	0,147

Table 2- Results of the linear multiple regression analysis between average speed (AS), lateral position (LP), average reaction time (RT) and headway distance (HD) under low(LTC) and high traffic conditions (HTC).

Analyzed Variables	AS		LP		RT		HD	
	LTC	HTC	LTC	HTC	LTC	HTC	LTC	HTC
MMSE	.23*	.14ns	.07ns	.01ns	.19ns	-.01ns	.09ns	-.12ns
FAB	.19ns	.24*	-.06ns	-.01ns	.15*	.13ns	.24*	-.13ns
CDT	.42*	.40*	-.14ns	.04ns	-.01ns	-.19ns	.31*	-.46*
TMT A	-.27*	-.39*	.01ns	-.04ns	.09ns	.22*	-.48*	-.48*
TMT B	-.42*	-.47*	.12ns	-.01ns	.12ns	.35*	-.41*	.25*
MoCA	.13ns	.29*	-.12ns	-.11ns	.16ns	-.09ns	.26*	-.22ns
Statistical Summary	R <sup>2</sup> =.23	R <sup>2</sup> =.25	R <sup>2</sup> =.35	R <sup>2</sup> =.14	R <sup>2</sup> =.13	R <sup>2</sup> =.15	R <sup>2</sup> =.24	R <sup>2</sup> =.38
	F=2.37*	F=2.71*	F=1.12	F=1.38	F=1.22	F=1.4	F=2.54*	F=4.71**

\*p≤.05; \*\*p≤.01

## DISCUSSION/ CONCLUSION

- Significant differences were observed between the control and the PD group on average speed and on average reaction time under high traffic conditions.
- The predictor model was able to account for 38% the variance in headway distance under high traffic conditions, as far as PD individuals are concerned.
- Three variables- CDT, TMT A & TMT B- added statistically significantly to the prediction, p<.05.
- Future studies should include a larger sample size and additional assessments of executive functions.

## REFERENCES

- Beratis I., Andronas N., Papadimitriou E., Pavlou D., Stamelou M., Tsivgoulis G., Stefanis L., Papageorgiou S.G., "Exploring indexes of driving performance in cognitively intact drivers and drivers with Parkinson's disease (PD)", 1st Congress of the European Academy of Neurology, Berlin, 20-23 June 2015
- Bott, N. T., Johnson, E. T., Schuff, N., Galifianakis, N., Subas, T., Pollock, J., ... & Possin, K. L. (2014). Sensitive measures of executive dysfunction in non-demented Parkinson's disease. *Parkinsonism & related disorders*, 20(12), 1430-1433.
- Chan, J., Deng, K. F., Wu, J. M., Liang, D. X., & Yan, J. H. (2018). Broad impairments of executive functions in Parkinson's patients: a meta-analysis. *Parkinsonism & Related Disorders*, 46, e66.
- Pavlou, D., Beratis, I., Papadimitriou, E., Antoniou, C., Yannis, G., & Papageorgiou, S. (2016). Which are the critical measures to assess the driving performance of drivers with brain pathologies?. *Transportation Research Procedia*, 14, 4393-4402.
- Ranchet, M., Paire-Ficout, L., Marin-Lamellet, C., Laurent, B., & Broussolle, E. (2010). Impaired updating ability in drivers with Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, jnnp-2009.