

Ageing and Safe Mobility

International
interdisciplinary conference



27th and 28th November 2014

at the

Federal Highway Research Institute

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National Technical University of Athens
National Kapodistrian University of Athens



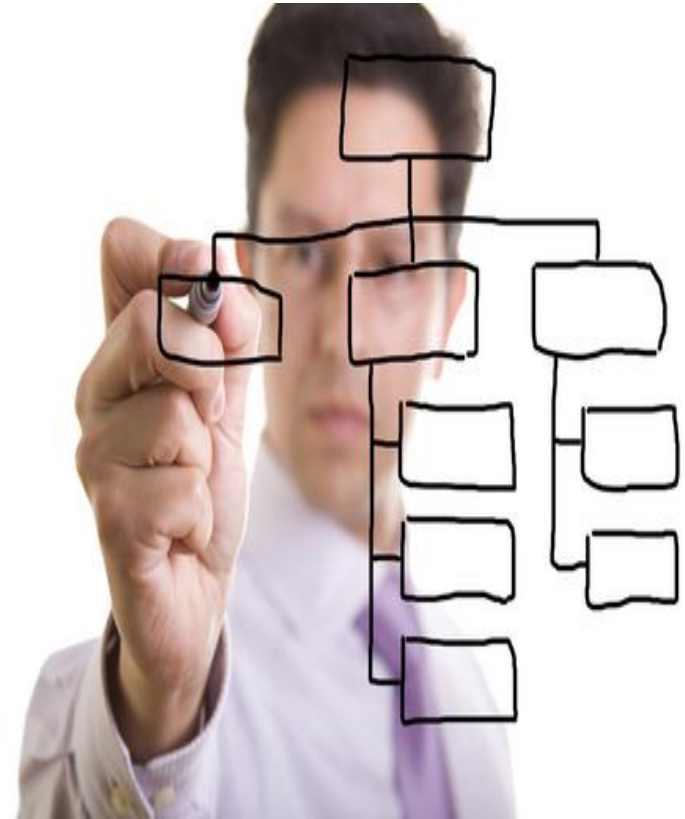
Exploring the Association between Working Memory and Parkinson's Disease in a Driving Simulator

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Presentation outline

- Introduction
- Objectives
- Research methods
- Participants
- Procedure
- Results
- Conclusions and discussion



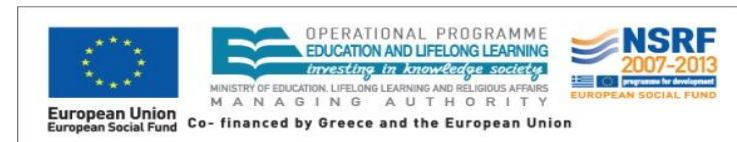
Introduction

- Road accidents
 - major social problem in modern societies
- Driving
 - complex activity - demands multitasking
- Older drivers
 - higher probability of getting involved in an accident
- Cerebral diseases (PD)
 - deteriorate driving performance



Interdisciplinary research

- The “**DriverBrain**” research project: “Analysis of the performance of drivers with cerebral diseases”
- The “**Distract**” research project: “Analysis of causes and impacts of driver distraction”
- An interdisciplinary research team, co-funded by the Greek Research Secretariat and the European Commission



Objectives

- A driving simulator was used to explore whether varying levels of operational and tactical driving task demand would differentially affect healthy drivers versus drivers with Parkinson's disease (PD) in their message recall.



Research methods

- FOERST Driving Simulator FPF (¼ cab)
 - 3 LCD screens (40"wide, 1920x1080pixels)
 - total field of view 170 degrees
- Participants:
 - PD group - 10 subjects (62.2±8.4 y.o., all males)
 - Control group - 10 subjects (57.6±5.1 y.o., 7 males)
 - age matched, driving experience and driving exposure matched
 - matched in terms of (self-reported) number of accidents within the last two years
 - neuropsychological tests showed that PD drivers had difficulties on recalling verbal material, on performing executive, attentional and working memory operations



Procedure 1/3

- Instructions before driving
 - try to respond to traffic control information and always maintain safe gaps with other vehicles just as they would when actually driving
 - maintain a constant speed at the posted speed limit unless they were forced to slow down due to road conditions
 - execute a lane change if a discriminative stimulus (activation of the brake lights on a lead vehicle) was presented
 - recall of a safety message after driving the trial



Procedure 2/3

- Safety Message before each trial
- Presented for exactly 8 seconds
- Three items of information:
 - a type of situation ahead
(i.e. ice)
 - a distance
(i.e. 4km)
 - a driver action that is required
(i.e. use of chain)
- the memory task involves cued recall at the end of each trial



Procedure 3/3

- 3 trials (randomised order, ~2min each)
 - **TC1-Demand Level 1**
 - only a low level of demand for intervening (between message presentation and recall), operational-level driving tasks
 - **TC2-Demand Level 2**
 - TC1 + a double lane change that involved driving through a road work section containing large blocks (barriers) on each side of the road
 - **TC3-Demand Level 3**
 - TC2 + presentation of the discriminative stimulus they were instructed (decision of a lane change - a cognitive task)

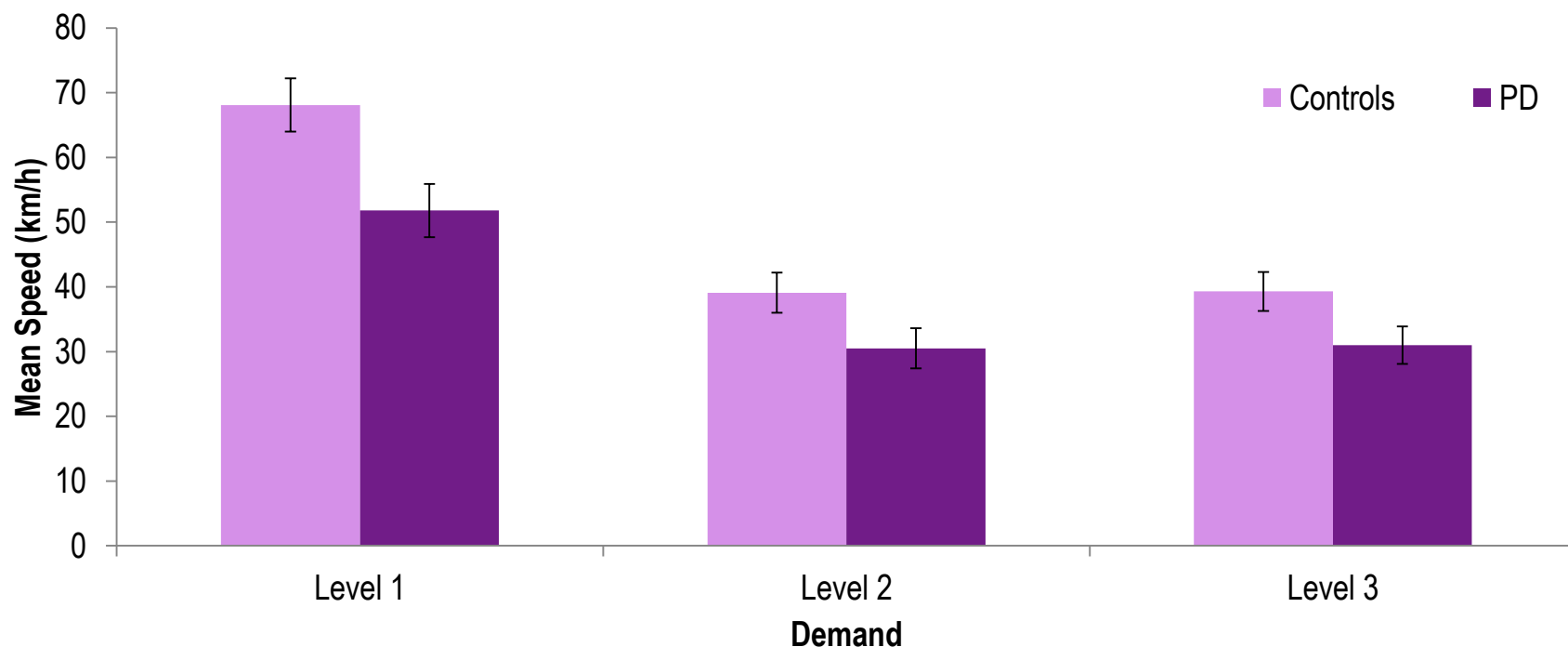


Results 1/3

- Two sets of data analyses were performed, concerning differences in
 - **drivers' speed choice** under each test condition, as a manipulation check that the hypothesized differences in task demand had operational consequences
 - **sign recall scores**, to evaluate the hypothesized deficit for PD drivers versus controls, and a potential interaction of sign message recall with task demand level



Results 2/3



- overall Level 1 mean speeds are higher than Levels 2 and 3
- mean speed of the PD group was lower than the control group across all Levels
- speeds at level 3 were not significantly different than speeds at level 2 (both $p > 0.05$)
- not statistically significant ($F(1.32, 36) = 1.42, p > 0.05$) interaction between group membership (medical status) and intervening task demand

Results 2/3

Parameter	B	Std. Error	Exp(B)	95% CI for Exp(B)		Hypothesis Test			
				Lower	Upper	Wald Chi-Square	df	Sig.	
Threshold	Recallscores =0	-1.93	0.94	0.14	0.02	0.91	4.26	1.00	0.04
	Recallscores=1	-1.00	0.70	0.37	0.09	1.45	2.04	1.00	0.15
	Recallscores=2	0.31	0.57	1.36	0.44	4.18	0.29	1.00	0.59
	Controls	0.53	0.68	1.70	0.45	6.41	0.61	1.00	0.43
PD	0								
TC1-Demand-Level1	0.72	0.48	2.05	0.79	5.29	2.19	1.00	1.00	0.14
TC2-Demand Level2	0.89	0.42	2.44	1.07	5.60	4.46	1.00	1.00	0.03
TC3-Demand Level3	0								

- General Estimating Equation model (Ordinal logistic GEE)
- controls were more likely to perform better than PD drivers in the sign recall task
 - (not statistically significant)
- subjects performed better in the recall of safety information in TC1 versus TC3
 - (not statistically significant)
- performance in the sign recall task was more likely to be higher in TC2 than TC3
 - (statistically significant)

Conclusions and discussion 1/2

- **The goal** was to determine whether varying levels of driving task demands would affect highway sign recall by healthy drivers vs. age matched PD drivers
- **Results** showed that performance in the sign recall task was more likely to drop with increasing task demand (statistically significant) when the variation in task demand was associated with a cognitive task
- The conclusions are tentative due to various limitations (small sample size)



Conclusions and discussion 2/2

- **Encouraging evidence** regarding the use of a driving simulator to identify performance differences that can discriminate (older) individuals with medical conditions that often cause loss of functions needed to drive safely from healthy drivers in the same age cohort.
- **Within its limitations**, such driving simulation in combination with measures of physical, visual and cognitive abilities shown to be significant predictors of older driver crash risk could comprise one component of a multi-tiered system to evaluate medical fitness-to-drive.



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