Compensatory strategies and driving adaptation techniques of people with mental disorders

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Abstract

Introduction: *The aim of the study was to investigate the compensatory strategies and driving adaptation techniques of people with mental disorders.* ***Methodology:*** *A total of 639 drivers were assessed on their driving ability. An extensive driving questionnaire was administered to 307 drivers and a group of Alzheimer's Disease (AD) patients aged 65 and over, which led to the creation of a 15-item short driving questionnaire. The short questionnaire was answered by 285 participants, 183 men (64.2%) and 102 women (35.8%). They were examined in the 3rd Department of Neurology of the "G. Papanikolaou" General Hospital, Aristotle University of Thessaloniki, and at Daycare Units for patients with dementia in Athens and Thessaloniki. The distribution of the population according to the diagnosis was: 88 healthy (30.9%); 100 with Mild Cognitive Impairment (MCI) (35.1%); 69 with AD (24.2%); 28 with other dementias (9.8%), all with no mobility problems. The AD patients were diagnosed according to the NINCDS-ARDRA criteria, the MCI ones according to the Petersen and Winblad criteria, while the other dementias according to the DSM-IV criteria, because the study had started before the DSM-V. The participants underwent neurological examination, neuropsychological and neuropsychiatric evaluations, medical/social history, neuroimaging, and hematological examinations. The healthy*

older adults were examined across the same neuropsychological battery. ***Results:*** *The percentage of family members who recommended driving cessation was higher in AD patients (47.7%) compared to the other diagnostic categories (p<0.001). More AD patients (58.7%) avoided unaccompanied driving compared to the other groups (p<0.001). Most AD patients (40.2%) avoided driving in urban areas (p<0.001). Most AD patients (47.1%) avoided driving on highways (p<0.001). More AD patients (38.6%) avoided driving in unknown areas compared to the other diagnostic categories (p<0.001).* ***Conclusions:*** *People with mental disorders reduce driving habits either on their own, adopting compensatory driving behaviors, or following family recommendations.*

Keywords: Mental Disorders, Dementia, Alzheimer's disease, Driving

JEL Classifications: I12, I13, R41

Introduction

Driving and commuting are complex activities and part of the Instrumental Activities of Daily Living and seem to be further categorized in the range of transport activities (American Occupational Therapy Association, 2014). In the particular case of driving, it is considered to be an activity that can facilitate the participation of older people in the community (Stav, 2014), allowing movement based on people needs, making it possible to participate in social and/or recreational activities (Bekiaris, Panou & Pioggia, 2008).

As a complex task, driving requires a combination of mental functions, including executive functions, visual awareness, ability to maintain attention, motor control and fast reaction speed (Drazkowski & Sirven, 2011). Even though it is an automated procedure, as far as the handling of the vehicle is considered, and is linked to implicit memory, its complexity is attributed to the processing of multiple and simultaneous stimuli [(e.g. distance assessment etc.) (Tsamaslidis, Tsantali & Tsolaki, 2005)].

Alzheimer's Disease (AD), one of the most prevalent diseases that seems to affect all the above-mentioned mental functions in the elderly (Alzheimer Association, 2019), also has found to adversely affect the ability to drive. Sensory and motor changes may occur as early as the preclinical stage, even before the onset of cognitive symptoms (Albers et al., 2015). Moreover, even slight deviations in cognitive impairment can affect driving, increasing the risk of car accidents (Fraade-Blanaret al., 2018). It is therefore necessary to assess the factors involved in driving in a timely and valid manner.

An appropriate way to assess the driving ability of people with mental disorders is the clinical examination, neuropsychological assessment, use of the driving simulator as well as the assessment of actual driving conditions (Katsouri & Tsolaki, 2013). Bennett, Chekaluk & Batchelor (2016), in the context of a systematic review, highlighted the correlation between attention, executive functions and visual spatial tests and driving ability. Similar correlations have been identified for the predictive usefulness of the Trail Making Test A and B, which also appear to be sensitive enough for early detection of Amnestic Mild Cognitive Impairment (Falkenstein, Karthaus & Brüne-Cohrs, 2020; Kalin et al., 2014) and, as a consequence, the identification of deficits related to declined ability as far as driving performance is concerned. Additionally, a qualitative study assessing the ability of experts in USA (n = 26, Driving Rehabilitation Specialists) to accurate evaluate the ability of driving in elderly, pointed out that occupational therapists appear to have the experience needed to deal with safety issues of older drivers (Jones, Dickerson, Belmashkan & Betz, 2016). It is

becoming clear that an all-out assessment of the driver would contribute to a valid diagnosis of driving-related deficits.
As Ma'u & Cheung (2020) point out, it is not the diagnosis itself that affects performance in driving projects but, rather, the specific mental deficits that occur in this context. The different patterns of dysfunction that patients with a mental impairment of different etiology seem to have (Piersmaetal., 2018), along with the increasing ageing of the population, make it imperative to develop sensitive and specific tests that will guide clinical practice.
The assessment of the driving ability in people with AD aims at identifying the remaining skills, taking into consideration both environmental factors and individual's interests, while the decision to cease driving seems to be influenced by older age as well as by gender, with this phenomenon being more pronounced among women (Puynetal, 2018; Tzonichaki, 2019). Furthermore, the existence of a supportive environment (Angetal, 2020) along with the reduced self-confidence of the patient in his driving skills (Hassan, King & Watt, 2017) seems to mediate in the decision to give up driving.
At first, in the beginning of the decline, importance is given to safety. The risk associated with driving seems to be higher at the stage prior to the clinical manifestation of dementia (predementia), given the time between diagnosis and the person's level of awareness. Whether or not MCI people are able to maintain their safety-oriented driving independence is not clearly defined by the existing guidelines, since MCI patient falls under the diagnosis of general term "mental disorders" and is, therefore, subject to multiple and broad interpretations (Olsen, Taylor & Thomas, 2014).
The development of compensatory strategies and the self-regulation of driving on behalf of patients point out, on the one hand, the awareness of the limitations imposed by progressive mental impairment (Fengetal, 2020; Pavlou et al, 2017). On the other hand, they may reflect the difficulties faced by this population group in carrying out the individual acts that form up the act of driving. Feng et al(2020)found that MCI patients compensate for their mental deficits at 62.4%. The most common strategies are driving during the night, during rain and parking in parallel. Other compensatory behaviors which may occur concern the limitation of the kilometers they drive, driving in well-known routes, avoid busy and slippery roads, avoid driving environments judged as demanding etc(Braitman & Williams,2012; Devlin & McGillivray, 2014; Meng & Shiren, 2012; O' Connor, Edwards & Baddon, 2013).
As noted by Kurtzhaler et al (2017) the above self-restrictive behaviors appear to occur in those conditions considered by the individual to be potentially difficult, and not so much in those assessed as easy, raising again the question of the safety of both the individual himself and the rest of people. What is more, the limited awareness that the individual may have, considering his deficits, may raise the risk of car accidents. Therefore, the study of the compensatory behaviors potentially displayed by the population group under discussion is set out as indicative, on the one hand, of the individual's knowledge of his or her reduced functionality and, on the other hand, as a prerequisite for achieving the safety required so as to continue driving.
Given the parameters involved, the responsibility for assessing the severity of the disorder and the maintenance of driving skills seems to be a matter for health professionals (Olsen et al, 2014). Furthermore, ceasing or restricting driving among people with mental disorders raises ethical issues, such as non-harm, autonomy, but also the ability to manage everyday issues (Gauthier, Leuzy, Racine & Rosa-Neto,2013), making it difficult for experts to formulate the decision. Risk that may accompany the continuation of driving along

with the potentially detrimental effects of ceasing driving it on should be taken into consideration by the experts who bear the above responsibility (Liddle, Turpin, Carlson & McKenna, 2008).

The purpose of this study was to investigate the compensatory strategies people with progressive mental impairment adopt, depending on their demographic characteristics and diagnosis, and test a potentially useful questionnaire that will help us to form a more accurate picture of driving behavior displayed by the population group under discussion.

Materials & Methods

Participants

The survey was carried out in 639 drivers, of whom 424 (66.4%) were men and 215 (33.6%) women. Most of them were married (77.3%) and retired (78.2%). Their age distribution was as follows: < 55: 79(12.4%), 55-64: 97(15.3%), 65-74: 240 (37.7%), 75-84: 197(31.0%), >=85: 23(3.6%). Their educational level ranged from 0 to 26 years.

Three hundred and seven 307 drivers were examined with an extended driving questionnaire, 285 were examined using the Short Driving Questionnaire, while for 47 of them the Short Driving Questionnaire was completed by their caregivers. Seventy nine (79) of them were also examined through a Driving Simulator at the Hellenic Institute of Transport in Center for Research & Technology Hellas (CERTH) in Thessaloniki. The participants were residents in Northern Greece and Attica.

Participants were diagnosed (a)with AD according to NINCDS-ARDRA criteria(McKhann, Drachman & Folstein,1984) (b) with MCI according to Petersen and Winblad criteria (Bekiaris et al., 2008; Petersen et al., 2010), (c) with other dementia according to DSMIV criteria and did not have any mobility problems at the time of examination. Neurological examination, neuropsychological and neuropsychiatric evaluations, medical/social history, neuroimaging and blood tests were conducted to support the diagnosis of AD and MCI. Healthy elderly people were also examined with the same neuropsychological battery.

Measures

Participants were administered the following array neuropsychological tests: (a)Mini Mental State Examination(MMSE)(Folstein, Folstein & McHugh,1975; Fountoulakis,Tsolaki, Chatzi & Kazis,2000), (b)Clock-drawing Test(Agrell & Dehljn,1998; Bozikis et al., 2003)(c)Functional Rating Scale for Symptoms of Dementia (FRSSD)(Hutton, Dippel & Loewenson, 1988)(d) Geriatric Depression Scale (GDS)(Fountoulakis et al., 1999; Yesavage et al., 1983), (e)Hamilton's Depression Rating Scale (HDRS)(Hamilton, 1960), (f)Functional-Cognitive Assessment Scale (FUCAS)(Kounti,Tsolaki & Kiosseoglou,2006; Tsolaki, Alexiadou, Kiosseoglou & Kounti, 2006), (g)Montreal (Montreal Cognitive Assessment MoCa)(Poptsi et al, 2019; Nasreddine et al, 2005), and (h)Neuropsychiatric inventory (NPI)(Cummings et al., 1994, Politis A. et al).The above-mentioned tests were used to define the severity and stage of AD and MCI and were both administered to the patients and their healthy counterparts. They were chosen based on their psychometric properties and their standardization in Greek population, while, generally, they also seem to be acceptable measurements.

For the specific purposes of this study, two questionnaires assessing the driving capacity have been identified in Europe: (a)the Aged people Integration, Mobility, Safety and Quality of Life Enhancing Through Living - (AGILE) questionnaire(Widlroither, Hangenmeyer, Breker & Panou, 2003), which was developed in order to identify new

driving assessment procedures and training methods for elderly drivers, aiming of maintaining safe driving capacity for as long as possible,(b)the Driving Questionnaire for dementia patients (Tsantali, Tsolaki & Tsamaslidis, 2006), which was developed to detect indicators ceasing driving and identify correlations between the driving behavior of the patient, in the early stages of AD, and their mental state. It seems to have good reliability and validity (Cronbach's alpha=.80) and is administered by the clinician to the patient himself, while the caregiver is also present to confirm the information given by the patient.
A combination of the above questionnaires was used to better control the variables of interest in the present study. The new driving questionnaire is consisted of 33 questions with 52 sub-questions and aims to collect personal info(e.g. gender, age, accidents in the past, driving self-assessment), aspects on training and evaluation (e.g. whether they had already undergone an assessment, their beliefs on it, their willingness to retrain), information on physical and mental ability (e.g. vision, hearing, memory, attention) as well as information about their driving habits (e.g. which traffic situations they try to avoid compared to a younger age).

Short Driving Questionnaire
Data in the short driving questionnaire were collected between October 2015 and September 2016. It was formed based on the results from the Extended Driving questionnaire when important findings emerged for 15 questions regarding people with AD, aged over 65, The important findings prompted us form and administer the Short Driving Questionnaire.

Procedure
The present study is part of the doctoral thesis of Ioanna Yannoula Katsouri (2018). Assessment of the patients was held at the Hospital "G. Papanikolaou" as well as in memory centers in the above-mentioned areas. Participation was voluntary and a consent formed was signed in advance.

Results
Two hundred and eighty seven (285) participants completed the questionnaire of interest, of whom 183 (64.2%) men and 102 (35.8%) women. The distribution of diagnosis was as follows: 88(30.9%) were healthy, 100(35.1%) were MCI patients, 69(24.2%) patients with AD, and 28(9.8%) were patients with other forms of dementia. Patients with MCI scored significantly higher in MMSE (27.22±1.75) than patients with other dementias (24.77±6.03), (p=0.012). Additionally, patients with AD scored significantly lower in MMSE (20.58±5.71) than those with other dementias (24.77±6.03), (p<0.001). More information on the composition of the sample is given in Table 2, in which case the results of the correlations between demographic/individual characteristics and diagnosis are summarized.
Descriptive statistics were used to statistically analyze the data obtained from the administration of the Short Driving Questionnaire as well as to investigate the possible correlations between the variables. Statistical analysis varied out using the IBMSPSS 22.0 statistical package (IBM Inc., Armonk. NY). P-values less than 0.05 were considered statistically significant. Table 1 summarizes the demographical features of the sample, illustrating the possible correlations between interpersonal/demographic variables and the diagnosis.

Table 1. Correlations between the demographic and individual characteristics of the sample and diagnosis

		Controls n (%)	MCI n (%)	AD n (%)	Other n (%)	Total (n)	P
Age	<55	10 (76.9)	0 (0.0)	0 (0.0)	3 (23.1)	13	**0.000**
	55-64	16 (59.3)	3 (11.1)	4 (14.8)	4 (14.8)	27	
	65-74	45 (30.8)	60 (41.1)	29 (19.9)	12 (8.2)	146	
	75-84	16 (18.0)	34 (38.2)	33 (37.1)	6 (6.7)	89	
	>85	1 (1.1)	3 (3.0)	3 (4.3)	3 (10.7)	10	
Gender	Men	49 (26.8)	60 (32.8)	56 (30.6)	18 (9.8)	183	**0.007**
	Women	39 (38.2)	40 (39.2)	13 (12.7)	10 (9.8)	102	
Residents of	Athens	63 (47.0)	36 (26.9)	20 (14.9)	15 (11.2)	134	**0.000**
	Thessaloniki	25 (16.6)	64 (42.4)	49 (32.5)	13 (8.6)	151	
Driving Simulator	Yes	15 (28.3)	21 (39.6)	17 (32.1)	0 (0.0)	53	**0.035**
	No	73 (31.5)	79 (34.1)	52 (22.4)	28 (12.1)	232	
Professional Driver	Yes	13 (27.1)	10 (20.8)	16 (33.3)	9 (18.8)	48	**0.016**
	No	75 (31.6)	90 (38.0)	53 (22.4)	19 (8.0)	237	
Retirement	Yes	69 (27.4)	93 (36.9)	67 (26.6)	23 (9.1)	252	**0.001**
	No	19 (57.6)	7 (21.2)	2 (6.1)	5 (15.2)	33	
Revised Driving License	Yes	56 (31.1)	70 (38.9)	37 (20.6)	17 (9.4)	180	0.188
	No	32 (30.5)	30 (28.6)	32 (30.5)	11 (10.5)	105	
Driving Licensefor Motorcycle	Yes	14 (60.9)	4 (17.4)	2 (8.7)	3 (13.0)	23	**0.007**
	No	74 (28.2)	96 (36.6)	67 (25.6)	25 (9.5)	262	
Driving License for Truck	Yes	13 (25.5)	12 (23.5)	18 (35.3)	8 (15.7)	51	**0.041**
	No	75 (32.1)	88 (37.6)	51 (21.8)	20 (8.5)	234	
Driving License for Bus	Yes	3 (21.4)	4 (28.6)	5 (35.7)	2 (14.3)	14	0.635
	No	85 (31.4)	96 (35.4)	64 (23.6)	26 (9.6)	271	

Statistically significant correlations of questionnaire questions in relation to diagnosis identified the following important findings:

• The highest proportion of healthy people (44.4%) continue to drive the same kilometers as in the past, compared to the other groups ($p=0.028$).

• The percentage of family members recommended ceasing driving is higher in patients with AD (47.7%) in relation to the other diagnostic categories ($p<0.001$).

• More patients with AD (57.7%) are in medication that cause driving problems compared to other categories (p<0.001).
• More patients with AD (45.6%) are easily distracted from driving in urban areas in relation to other diagnostic categories (p<0.001).
• More patients with AD (42.9%) have problems concentrating on driving for more than half an hour compared to the other groups (p=0.005).
• Less patients with other dementias (15.3%) have difficulty concentrating on driving when someone is talking to them in relation to the other diagnostic categories (p=0.006).
• More patients with AD (35.3%) and people with other dementias (13.2%) have an inability to react quickly when necessary, compared to the other groups (p=0.028).
• More patients with AD (40.2%) avoid driving in urban areas (p<0.001).
• More patients with AD (47.1%) avoid driving on motorways (p<0.001).
• More patients with AD (58.7%) avoid driving without an escort compared to other groups (p<0.001).
• More patients with AD (42.5%) avoid turning to difficult intersections compared to other diagnostic categories (p<0.001).
• More patients with AD (40.7%) avoid driving under the pressure of time compared to the other categories (p<0.001).
• As far as patients with AD are concerned (31.7%) the average speed is slower today than when he was 45 years old compared to the other groups (p<0.001).
• More patients with AD (38.6%) avoid driving in unfamiliar areas compared to other diagnostic categories (p<0.001).

The statistically significant correlations are summarized in Table 2.

Table 2. Correlations between driving behavior and distraction

		Controls n (%)	MCI n (%)	AD n (%)	Other n (%)	Total (n)	P
Driving the same amount of km as in the past	Yes	32 (44.4)	23 (31.9)	12 (16.7)	5 (6.9)	72	**0.028**
	No	56 (26.3)	77 (23.2)	57 (26.8)	23 (10.8)	213	
Complaints from the family members about driving behavior	Yes	17 (27.4)	16 (25.8)	20 (32.3)	9 (14.5)	62	0.105
	No	71 (31.8)	84 (37.7)	49 (22.0)	19 (8.5)	223	
Recommendations about ceasing driving from the family	Yes	10 (15.4)	16 (24.6)	31 (47.7)	8 (12.3)	65	**0.000**
	No	78 (35.5)	84 (38.2)	38 (17.3)	20 (9.1)	220	
Medication that affects driving	Yes	1 (3.8)	4 (15.4)	15 (57.7)	6 (23.1)	26	**0.000**
	No	87 (33.6)	96 (37.1)	54 (20.8)	22 (8.5)	259	
Easily distracted during driving for ex. In urban areas	Yes	11 (19.3)	13 (22.8)	26 (45.6)	7 (12.3)	57	**0.000**
	No	77 (33.8)	87 (38.2)	43 (18.9)	21 (9.2)	228	
Difficulties in concentrating during driving for over half an hour	Yes	6 (14.3)	12 (28.6)	18 (42.9)	6 (14.3)	42	**0.005**
	No	82 (33.7)	88 (36.2)	51 (21.0)	22 (9.1)	243	

Difficulties in concentrating when someone speaks to them	Yes	20 (20.4)	33 (33.7)	30 (30.6)	15 (15.3)	98	**0.006**
	No	68 (36.4)	67 (35.8)	39 (20.9)	13 (7.0)	187	
Inability to react quickly when necessary	Yes	14 (20.6)	21 (30.9)	24 (35.3)	9 (13.2)	68	**0.028**
	No	74 (34.1)	79 (36.4)	45 (20.7)	19 (8.8)	217	
Avoiding driving in urban areas	Never	72 (40.4)	66 (37.1)	26 (14.6)	14 (7.9)	178	**0.000**
	Always	16 (15.0)	34 (31.8)	43 (40.2)	14 (13.1)	107	
Avoiding driving in highways	Never	77 (35.80	84 (39.1)	36 (16.7)	18 (8.4)	215	**0.000**
	Always	11 (15.7)	16 (22.9)	33 (47.1)	10 (14.3)	70	
Avoiding driving at night	Never	57 (35.4)	58 (36.0)	30 (18.6)	16 (9.9)	161	0.063
	Always	31 (25.0)	42 (33.9)	39 (31.5)	12 (9.7)	124	
Avoid turning at difficult intersections	Never	74 (36.1)	77 (37.6)	35 (17.1)	19 (9.3)	205	**0.000**
	Always	14 (17.5)	23 (28.8)	34 (42.5)	9 (11.3)	80	
Avoiding driving without company	Never	83 (37.4)	88 (39.6)	32 (14.4)	19 (8.6)	222	**0.000**
	Always	5 (7.90	12 (19.0)	37 (58.7)	9 (14.3)	63	
Avoiding driving under time pressure	Never	73 (37.6)	73 (37.60	32 (16.5)	16 (8.2)	194	**0.000**
	Always	15 (16.5)	27 (29.7)	37 (40.7)	12 (13.2)	91	
Average speed is slower than when they were younger (45 y.o.)	Yes	37 (22.6)	53 (32.3)	52 (31.7)	22 (13.4)	164	**0.000**
	No	51 (42.1)	47 (38.8)	17 (14.0)	6 (5.0)	121	
Avoiding driving in unknown areas	Never	62 (39.20	61 (38.6)	20 (12.7)	15 (9.5)	158	**0.000**
	Always	26 (20.50	39 (30.7)	49 (38.6)	13 (10.2)	127	

Discussion

Considering the previous results, a differentiation in driving ability, driving habits, strategies, behavior and frequency of driving between those with mental disorders and their healthy counterparts is being made. Our study lacks the establishment of a statistically significant difference in rate of car accidents between diagnostic groups, which is probably due to the fact that people with mental disorders restrict driving either on their own or based on the recommendation of the family and the doctors in Greece. As Carr, Duchek & Morris (2000) pointed out, the non-statistically significant difference in car accidents between dementia patients and healthy controls is indicative of the existence of compensatory mechanisms.

Family's complaints to cease driving are more pronounced among patients with AD, underlining the contribution of the family to the regulation of driving-related parameters, as highlighted by Piersma et al. (2018). The perceived difficulties in concentration of

attention and rapid response, when needed, among patients with AD highlights the patient self-perception of the gradually evolving mental deficits, in accordance with the results presented by Pavlou et al. (2017). The above knowledge seems to be the prerequisite to adopt compensatory strategies. As stated in a review held by Ang, Jennifer, Chen & Lee (2019), patients seem to recognize progressive cognitive impairment by self-regulating their driving habits, accordingly. On the opposite hand, the inability to grasp these deficits seems to prevent the subsequent adjustment of behavior.

Talking specifically about the use of compensatory strategies, patients with AD were found to avoid driving in urban areas, on highways and in areas unknown to them, a finding that is supported from previous research in the field, indicating the avoidance of crowded and/or unknown areas in people with mental deficits (O' Connors et al., 2013). Similarly, in a large-range European study (Sommer, Falkmer, Bekiaris & Panou, 2004), which examined 473 older drivers, aged between 55-64, 65-74, and > 74 years old, it was highlighted that MCI patients avoided unfamiliar areas and high-traffic roads more than the healthy ones. This finding was attributed to the fact that people with MCI and dementia avoid driving in complex conditions on their own, reinforcing the view that they are capable of self-regulating driving skills. Therefore, there seems to be an agreement on the use of compensatory strategies, on behalf of these patients. On the other hand, the previous study, also, pointed out an increase in crash rates in which elderly people had the legal responsibility, finding that was not established in our research.

Avoiding turning at difficult intersections, driving without an escort and under the pressure of time were found to be statistically significantly correlated with the diagnosis of AD, suggesting that the observed decline in functionality is associated with avoiding conditions that pose additional requirements to the individual (Mang & Siren, 2012). The statistically significant reduction in speed is indicative of the compensation of the ability to react quickly and to sustain their attention, and is in line with previous findings (Katsouri, Athanasiadis, Bekiaris, Touliou & Tsolaki, 2015). Furthermore, no statistically significant decrease in driving during the evening hours was found, a finding widely noted in the literature (Babulal et al, 2019. Braitman & Williams,2012 etc.).

It seems, therefore, that patients facing cognitive decline, self-access the impairment of their functionality and, consequently, self-regulate their driving behavior to avoid demanding situations. On the other hand, the prolonged choice of easy driving conditions could reduce the individual's awareness of the existing declines, as pointed out by Kurtzhaler et al. (2017), raising security issues. Consequently, the self-regulation of driving behavior along with the existence of modifying factors, as far as ceasing driving is concerned, pronounce the need to establish sensitive enough tools in detecting deficits while considering patient’s personal point of view. Furthermore, the progressive decline in functionality and the consequences that these decline poses in driving ability, make the need for regular re-examinations imperative (Davis et al., 2017). Applying the person-centered approach to occupational therapy, concentrating on the remaining capability of driving, giving older drivers the opportunity to self-assess their abilities and the probability of handling their own deficiencies, regarding driving, on a realistic basis (Soemer et al, 2004), could give us a more accurate depiction of the decline of driving ability.

To conclude, it seems that people with cognitive deficits restrict their driving behavior either on their own, through compensatory strategies, or on the recommendation of family. This knowledge could be useful for the establishment of a more thorough assessment of

driving ability in this population, as well as, for the formation of appropriate intervention programs.

References

Agrell, B. & Dehljn, O. (1998). The clock-drawing test. A review. *Age Ageing, 27*, 399-403.

Albers, M. W., Gilmore, G. C., Kaye, J., Murphy, C., Wingfield, A., Bennett, D. A., et al. (2015). At the interface of sensory and motor dysfunctions and Alzheimer's disease. *Alzheimer's Dement, 11*, 70–98.

Alzheimer's Association (2019). Alzheimer's disease facts and figures. *Alzheimer's Dement. J., 15*, 321–387.

American Occupational Therapy Association (2014). Occupational therapy practice framework: Domain and process (3rd ed.). *Am J Occup Ther, 68*(1), 1-48.

Ang, B. H., Jennifer, O., Chen, W. S., & Lee, S. (2019). Factors and challenges of driving reduction and cessation: A systematic review and meta-synthesis of qualitative studies on self-regulation. *Journal of safety research*, *69*, 101–108.

Ang, B. H., Oxley, J. A., Chen, W. S., Yap, M., Song, K. P., & Lee, S. (2020). The influence of spouses and their driving roles in self-regulation: A qualitative exploration of driving reduction and cessation practices amongst married older adults. *PloS one*, *15*(5), e0232795.

Babulal, G. M., Stout, S. H., Benzinger, T. L. S., Ott, B. R., Carr, D. B., Webb, M., Traub, C. M., Addison, A., Morris, J. C., Warren, D. K., & Roe, C. M. (2019). A Naturalistic Study of Driving Behavior in Older Adults and Preclinical Alzheimer Disease: A Pilot Study. *Journal of Applied Gerontology*, *38*(2), 277–289.

Bekiaris, E., Panou, M. & Pioggia G. (2008). An innovative framework for elderly-friendly transportation and driver support services. *15th World Congress on Intelligent Transport Systems and ITS America's*. Annual Meeting.

Bennett, J., Chekaluk, E. & Batchelor, J. (2016). Cognitive tests and determining fitness to drive in dementia: A systematic review. *J Am Geriatr Soc., 64,* 1904–17.

Bozikas, V. P., Kosmidis, M. H., Kourtis, A., Gamvrula, K., Melissidis, P., Tsolaki, M. & Karavakos, A.(2003). Clock drawing test in institutionalized patients with schizophrenia compared with Alzheimer Disease patients. *Schizophr Res, 59*, 173-179.

Braitman, K. A, Williams, A. F. (2012). Changes in self-regulatory driving among older drivers over time. *Traffic Inj Prev, 12*(6), 568–575.

Carr, D. B., Duchek, J., Morris, J. C. (2000). Characteristics of motor vehicle crashes of drivers with dementia of the Alzheimer type. *J. Am. Geriatr. Soc., 48*, 18–22.

Cummings, J. L., Mega, M/, Gray, K., Rosenberg-Tompson, S., Carusi, D. A., Gornbein, J. (1994). The Neuropsychiatric Inventory: comprehensive assessment of psychopathology in dementia. *Neurology, 44*, 2308-2314.

Devlin, A. & McGillivray, J.A.(2014). Self-regulation of older drivers with cognitive impairment: a systematic review. *Australas J Ageing, 33*(2), 74–80.

Drazkowski, J. & Sirven, J. (2011). Driving and Neurologic Disorders. *Neurology, (76)*, 44–49.

Falkenstein, M., Karthaus, M., & Brüne-Cohrs, U. (2020). Age-Related Diseases and Driving Safety. *Geriatrics (Basel, Switzerland)*, *5*(4), 80.

Feng, Y. R., Meuleners, L., Stevenson, M., Heyworth, J., Murray, K., & Maher, S. (2020). Driver Self-Regulation Practices in Older Drivers with and Without Mild Cognitive Impairment. *Clinical interventions in aging*, *15*, 217–224.

Folstein, M. F., Folstein, S. E. & McHugh, P. R. (1975). Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. *J Psych Res, 12*, 189–98.

Fountoulakis, K., Tsolaki, M., Chatzi, E.&Kazis, A. (2000). MINI MENTAL STATE EXAMINATION (MMSE). A validation study in Greek patients with dementia. *Am J Alzheimers Dis Other Demen*, *15*, 342-347.

Fountoulakis, K., Tsolaki, M., Iacovides, A., Yesavage, J., O'Hara, R., Kazis, A., Ierodiakonou, Ch.(1999). The validation of the short form of the Geriatric Depression Scale (GDS) in Greece. *Aging Clin Exp Res, 11*:967-972.

Fraade-Blanar, L. A., Ebel, B. E., Larson, E. B., Sears, J. M., Thompson, H. J., Chan, K., & Crane, P. K. (2018). Cognitive Decline and Older Driver Crash Risk. *Journal of the American Geriatrics Society*, *66*(6), 1075–1081.

Gauthier, S., Leuzy, A., Racine, E. & Rosa-Neto, P. (2013). Diagnosis and management of Alzheimer's disease: Past, present and future ethical issues. *Prog Neurobiol, 110*, 102–113.

Hamilton, M. (1960). Rating scale for depression. *J Neurol Neurosurg Psychiatry, 23*, 56-62.

Hassan, H., King, M., & Watt, K. (2017). Examination of the precaution adoption process model in understanding older drivers' behavior: An explanatorystudy. *Transportation Research Part F: Traffic Psychology and Behaviour, 46*, 111–123.

Hutton, J. T., Dippel, R. L. & Loewenson, R. B. (1988). Functional rating scale for the symptoms of dementia. In J. J. Gallo, W, Reichel and L, Andersen (Eds.) Handbook of geriatric assessment. *Rockville, MD: Aspen Publishers*, 77-80.

Jones, J., Dickerson, A., Flaten, H. K., Belmashkan, S., & Betz, M. E. (2016). Driving Rehabilitation Specialists' Perspectives on Older Driver Evaluations. *The American journal of occupational therapy: official publication of the American Occupational Therapy Association*, *70*(2), 1-7.

Kälin, A. M., Pflüger, M., Gietl, A. F., Riese, F., Jäncke, L., Nitsch, R. M., & Hock, C. (2014). Intraindividual variability across cognitive tasks as a potential marker for prodromal Alzheimer's disease. *Frontiers in Aging Neuroscience, 6,* Article 147.

Katsouri, I. (2018). *Evaluating the driving ability of older adults with dementia.* Thesis/dissertation. Medical Department, Aristotle University of Thessaloniki. https://www.didaktorika.gr/eadd/handle/10442/42720.

Katsouri, I., Athanasiadis, L., Bekiaris E, Touliou,K.& Tsolaki, M. (2015). Mild Cognitive Impairment and Driving Habits. *International Journal of Prevention and Treatment*, *4*(2A), 1-10.

Katsouri, I., & Tsolaki, M. (2013). Occupational therapy assessment of safe driving ability for elderly with Alzheimer disease. *Rev. Clin. Pharmacol. Pharmacokinet. Int. Ed.*, *31*(3), 158-164.

Kounti, F., Tsolaki, M., Kiosseoglou, G. (2006). Functional Cognitive Assessment Scale (FUCAS): a new scale to assess executive cognitive function in daily life activities in patients with dementia and mild cognitive impairment. *Human Psychopharmacol Clin Exp, 21*, 305-311.

Kurzthaler, I., Kemmler, G., Defrancesco, M., Moser, B., Fleischhacker, W. W., & Weiss, E. M. (2017). Executive Dysfunctions Predict Self-Restricted Driving Habits in Elderly

People with or without Alzheimer's Dementia. *Pharmacopsychiatry*, *50*(5), 203–210.

Liddle, J., Turpin, M., Carlson, G., McKenna, K.(2008). The needs and experiences related to driving cessation for older people. *Br J Occup Ther, 71*, 379–88.

Ma'u, E., & Cheung, G. (2020). Ability of the Maze Navigation Test, Montreal Cognitive Assessment, and Trail Making Tests A & B to predict on-road driving performance in current drivers diagnosed with dementia. *The New Zealand medical journal*, *133*(1513), 23–32.

McKhann, G., Drachman, D. & Folstein, M. et al. (1984). Clinical diagnosis of Alzheimer's disease Report of the NINCDS-ADRDA work group under the auspices of Department of Health and Human Services Task force on Alzheimer's Disease. *Neurology, 34*, 939–44.

Meng, A. & Siren, A. (2012). Cognitive problems, self-rated changes in driving skills,driving-related discomfort and self-regulation of driving in old drivers. *Accid Anal Prev, 49*, 322–329.

Nasreddine, Z., Phillis, N., Bedirian, V., Charbnneau, S., Whitehead, V., Collin, I. et al. (2005). The Montreal Cognitive Assessment (MoCA): A brief screening tool for mild cognitive impairment. *J Am Geriatr Soc, 53*, 695-699.

O'Connor, M. L., Edwards, J. D., Bannon, Y. (2013). Self-rated driving habitsamong older adults with clinically-defined mild cognitive impairment,clinically-defined dementia, and normal cognition. *Accid Anal Prev, 61*, 197–202.

Olsen, K., Taylor, J. P. & Thomas, A.(2014). Mild cognitive impairment: Safe to drive? *Maturitas, 78*, 82-85.

Pavlou, D., et al., (2017). Self-assessment of older drivers with brain pathologies: reported habits and self-regulation of driving. *Journal of Transport & Health, 4*, 90-98.

Petersen, R. C., Roberts, R. O., Knopman, D. S., Geda, Y. E, Cha, R. H., Pankratz, V. S., … Rocca, W. A. (2010). Prevalence of mild cognitive impairment is higher in men. The Mayo Clinic Study of Aging. *Neurology 2010; 75*, 889–97.

Piersma, D., Fuermaier, A., De Waard, D., Davidse, R. J., De Groot, J., Doumen, M., Ponds, R., De Deyn, P. P., Brouwer, W. H., & Tucha, O. (2018). Adherence to driving cessation advice given to patients with cognitive impairment and consequences for mobility. *BMC geriatrics*, *18*(1), 216.

Poptsi E, Moraitou D, Eleftheriou M, Kounti-Zafeiropoulou F, Papasozomenou C, Agogiatou C, Bakoglidou E, Batsila G, Liapi D, Markou N, Nikolaidou E, Ouzouni F, Soumpourou A, Vasiloglou M, Tsolaki M. Normative Data for the Montreal Cognitive Assessment in Greek Older Adults With Subjective Cognitive Decline, Mild Cognitive Impairment and Dementia. J Geriatr Psychiatry Neurol. 2019 Jun

Pyun, J. M., Kang, M. J., Kim, S., Baek, M. J., Wang, M. J., & Kim, S. (2018). Driving Cessation and Cognitive Dysfunction in Patients with Mild Cognitive Impairment. *Journal of clinical medicine*, 7(12), 545.

Sommer, S. M., Falkmer, T., Bekiaris, E., Panou, M. (2004). Toward a client-centred approach to fitness-to-drive assessment of elderly drivers. *Scand J Occup Ther, 11*(2), 62-69.

Stav, W.B. (2014). Updated systematic review on older adult community mobility and driver licensing policies. *Am J Occup Ther, 68*, 681-689.

Tsamaslidis, T., Tsantali, E., Tsolaki, M. (2005). Until when can drive patients with dementia. 4th Panhellenic Conference on Alzheimer's Disease and related disorders, Thessaloniki Greece, *Encephalos*, 42:39.

Tsantali, E., Tsolaki, M., & Tsamaslidis, T. (2006). The discount is extended functions in the early stages of dementia-The case of

driving-*Geriatric Conference*, Thessaloniki, 1-3March, 2006. [inGreek]

Tsolaki, M., Alexiadou, A., Kiosseoglou, G., Kounti, F. (2006). Correlation between the Functional Cognitive Assessment Scale and Alzheimer's Disease Assessment Scale when administered to patients with dementia residing in long –term care. *Am J Alzheimers Dis Others Demen, 21*, 274-80.

Tzonichaki, I. (2019). Elderly psychiatric disorders, Occupational therapy assessment of people with Alzheimer's dementia. In chapter 11: *Occupational therapy for the elderly*. G.B.Parisianos, Athens, 59. [in Greek]

Yesavage, J.A., Brink, T.L., Rose, T.L., Lum, O., Huang, V., Adey, M.B., Leirer, V. (1983). Development and validation of a geriatric depression screening scale: A preliminary report. *J Psychiatr Res, 17*, 37-49.

Widlroither, H., Hangenmeyer, L., Breker, S., Panou, M. (2003). On designing automotive HMIs for elderly drivers: the AGILE initiative In: Human-Computer Interaction: Theory and Practice (Part II). *Lawrence Erlbaum Associates, Mahwah, New Jersey*, 323-327.