



The impact of attentional and executive impairments on driving abilities in normal aging and Alzheimer disease

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Invited symposium on

« Attentional failures and driving performance »



Dementia of Alzheimer type (DAT) and driving

- DAT drivers have degraded driving abilities (*Fitten et al 1995, Dobbs 1997, Uc et al 2004*)
 - Variability in the driving performance
- DAT drivers have limited awareness about their cognitive abilities
 - Less possibilities to self regulate their driving (*Marottoli et al 1993, Ball et al 1998*)
- DAT drivers tend to resume driving at late stages of the disease (*Hermann et al 2006*)
- Road safety issues are more concerned with early DAT drivers and drivers with mild cognitive deficits

Do attentional deficits negatively impact the fitness to drive in early DAT and older drivers?



Experimental set up

Sample

– Early DAT/Controls:

- 20 subjects, 73 years old (± 5) ; MMSE=26.4 (± 2.2)
- 20 subjects matched on age, sex and education; MMSE=29.1 (± 1.1)

– Very Mild Attentional Impairment (VMAI)/Controls:

- 18 subjects, 70 years old (± 6), MMSE=28.6 (± 1.4); with poor performances at 2 cognitive tests
- 18 subjects matched on age, sex and education; MMSE=29.3 (± 0.8)



Experimental set up

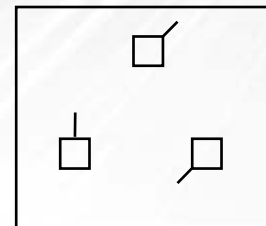
- **Cognitive evaluation**

- **Paper and pencil tests**

- MMSE
 - Zazzo Cancelation test
 - Benton Visual Retention Test
 - Isaac's set test
 - Weschler Digit Symbol Substitution test

- **Computerized tests (Amiéva et al 2002)**

- Reaction time (simple and choice)
 - Stop Signal task
 - Go-no go task
 - Stroop test
 - Dual task
 - Finger taping task



+ semantic task
(auditory + vocal)

Experimental set up

On traffic Driving assessment

- 45 min drive
- Various driving contexts: urban, sub-urban, free-way
- Specific car equipped with dual commands and video
- Driving instructor
- Observer who analyzed driving activity and rate actions with a specific tool





Driving score

Check Point n°	1	5	6	20
Guided/NonGuided	G	G	G	NG
Type of Situation				
Mirror Check		1	1 (Cycle Tr)	
Visual Search	1			1.....1
Indicator Use	1	1 late	1	1.....1
Lane Choice	1	1	1	1
Direction Following	? + Int	? + Int	? + Int	? + Int
Speed		Slow Fast	Slow Fast	Slow Fast
Violation	S	F		CP
Positioning at Intersection				Bad dang.

Rating made by the observer at the rear of the car and cross check with the video recording of the driving session

Driving score obtained by the addition of all penalties points: the higher it is, the poorer is driving performance





Driving performance evaluation

- **Driving score**

- Rating based on the number of penalty points: takes into account *Dobbs et al (1998)* recommendations
- Items used in the rating tools are clustered in 3 sub-categories
 - Visual exploration (Mirrors, road environment)
 - Planning (Line Choice, Follow-up a direction, Indicators)
 - Respect of traffic Rules (Road signs, traffic light, priorities)

- **Driving instructor safety interventions**

Steering wheel Accelerator Brakes

- **Driving instructor ratings**

Safe Borderline Unsafe





Results: Cognitive assessment

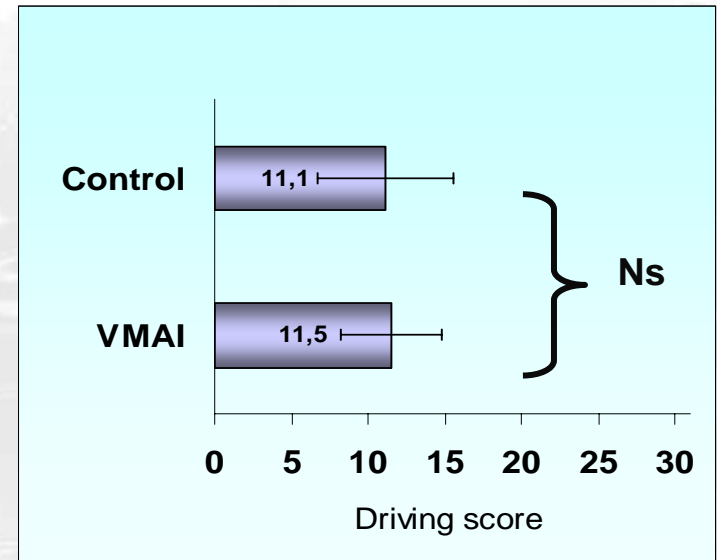
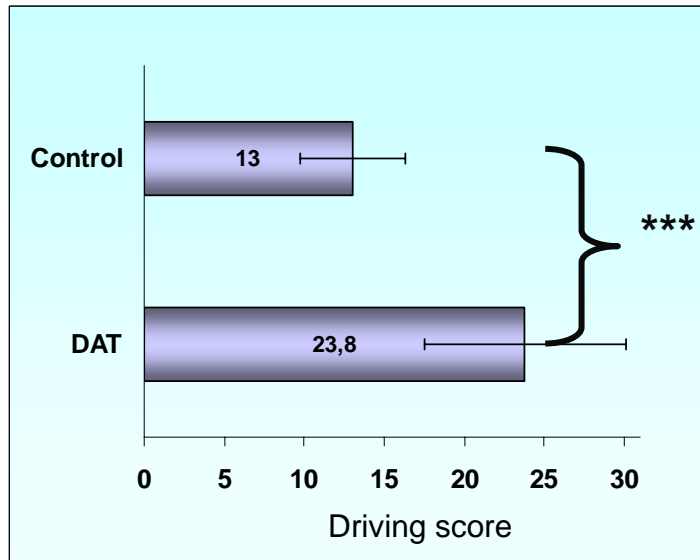
- **Early DAT**
 - Patients were significantly slower than their controls
 - Response time increased but the accuracy level of the answers are preserved for all but three tests:
 - Benton test
 - Stroop test
 - Main task in the dual task situation (visuo spatial)
- **VMAI**
 - No significant differences with controls for response time and accuracy measures except:
 - Tests used for the selection
 - Main task in the dual task situation (visuo spatial)





Results: Driving assessment

Driving score



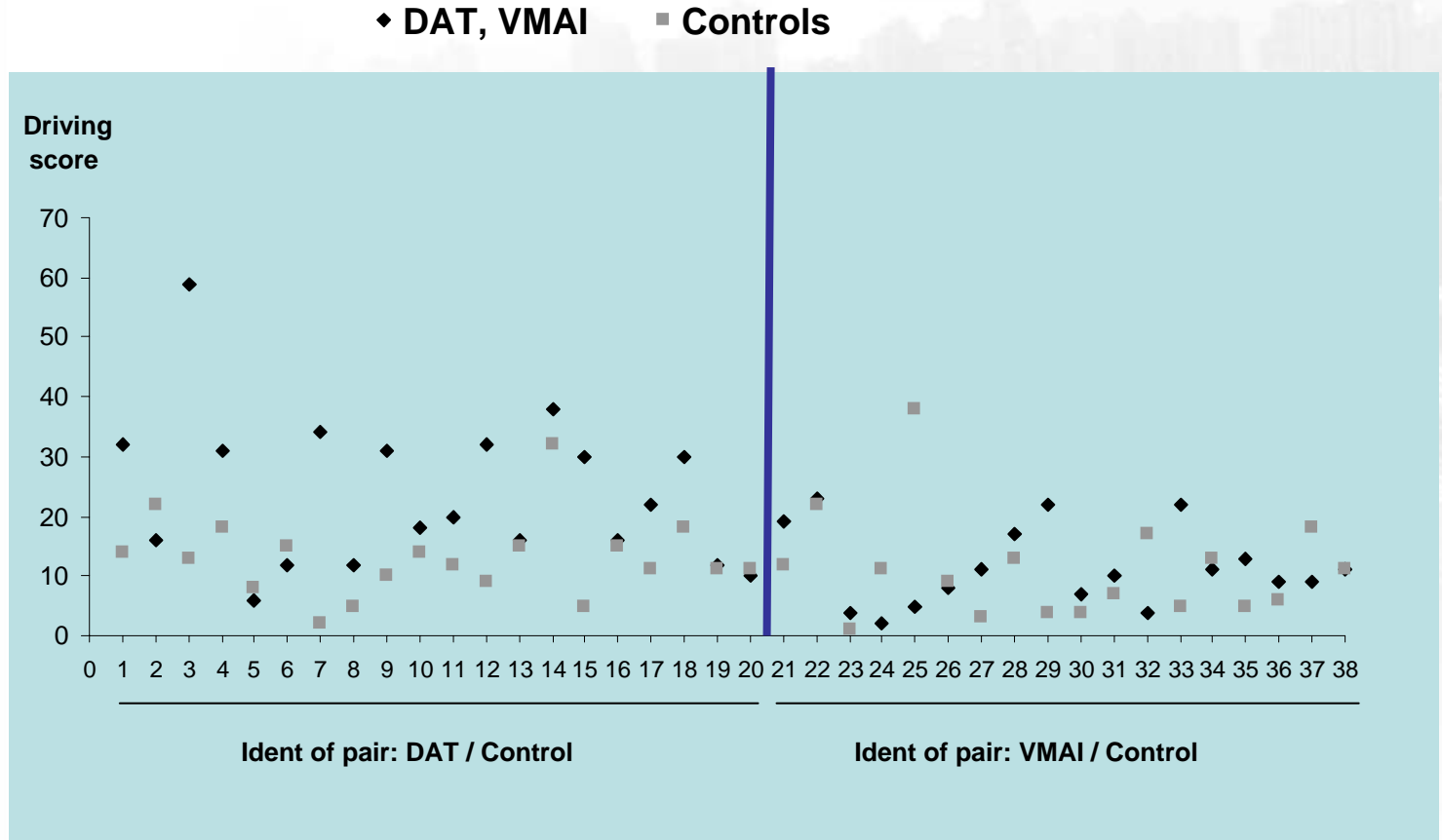
Sub-scores of driving performance are significantly poorer in DAT group than in the control group

- Visual exploration (mirrors)
- Planning (line choice)
- Respect of traffic Rules (traffic light)

No differences in VMAI subjects



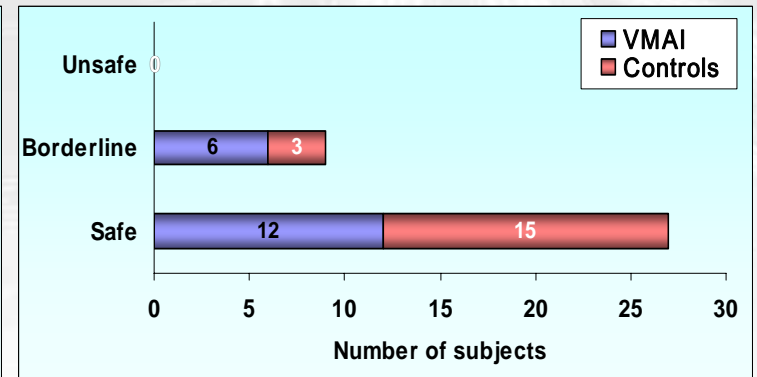
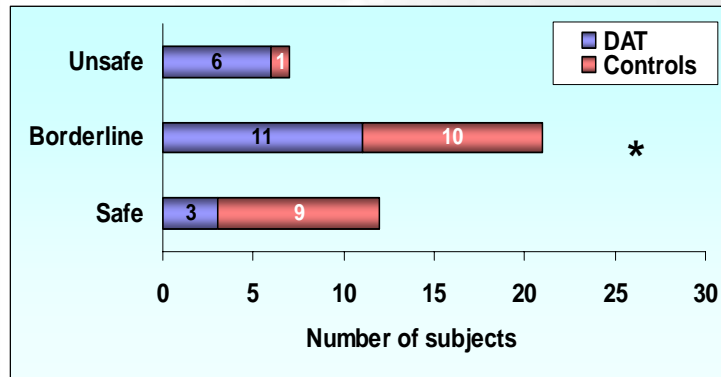
Results: Driving assessment Individual performance



Results: Driving assessment

Driving instructor

- **Driving instructor safety interventions**
 - Significantly more safety interventions with Early DAT in comparison with controls
 - No difference between VMAI and their controls
- **Driving instructor ratings**



- A lot of patients are rated as borderline, as well as half of the DAT Controls



Results: Relationship between Cognitive and Driving performances

- Analysis conducted on the whole group of subjects (n=76)
- Significant correlations between the three driving performance indicators and processing speed and reaction times tests
- Few accuracy performances at cognitive tests showed significant correlation with driving indicators:
 - Main task in the dual task situation (visuo-spatial) with the three driving performance indicators
 - Benton Visual Retention Test with driving score and number of safety interventions from the driving instructor



Conclusions

- Early DAT patients present attentional and executive deficits which affect their abilities to drive safely
 - The combination of the three driving assessment criteria is useful to identify unsafe drivers
 - At early stage of DAT, main cognitive deficits related to driving seem to be due to a cognitive slowing more pronounced than in normal aging
 - At the time of the test, half of the early DAT are classified as safe drivers
- Diagnosis of DAT must not be used alone to decide to resume driving
- Timed cognitive tests should be recommended for a better estimation of the fitness to drive





- **Thank you for your Attention !**

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