

Performance analysis in a VR-based assessment of cognitive planning

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Introduction

- Planning: Ability to organize a behavior in a spatio-temporal context *Lezak, 1990*
- Context: Aging, Brain damage
 - Parkinson's Disease (PD) *Owen, Doyon, 1999*
- Need: Tools of detection and rehabilitation

→ Virtual Reality based assessment

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2 main motivations: 3D objects and virtual tools



Klinger E., Marié R.M. et al., 2002-2005, GREYC-ENSICAEN, CHU de Caen

- Verbal information :
 - In the supermarket, you should buy: one baguette; green apples; a 2kg drum of washing powder; one kilo of flour; a tee-shirt for child; two artichokes; and beige socks.
 - You may pay by clicking on the purse icon that is on the screen.



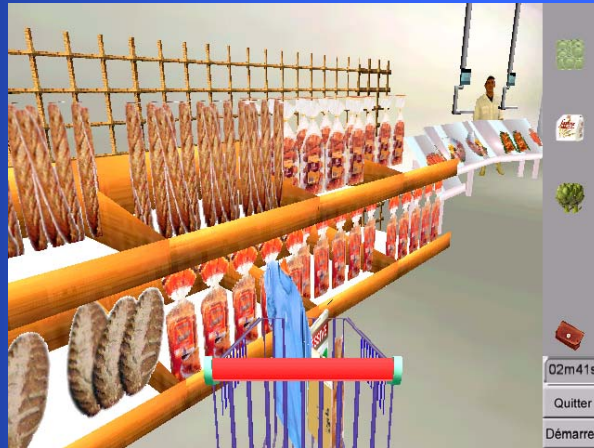
Marié et al., 2003

List display on the screen

Software

Assessment Session

- The user
 - Selects items by using the mouse
- The items
 - Appear in the kart
 - Disappear from the icon list



Feedback cues

Record of positions, time and actions

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Method

Participants

- Participants (n=24)
 - 13 patients with PD ↔ 11 age-matched volunteers
 - Same level of education (pre or post high school)
 - Inclusion criteria

	PD Patients (5 F, 8 M)	Controls (8 F, 3 M)	U	p
Age	71.1 ± 4.7	67.2 ± 5.6	45	0.134
Mattis	132.7 ± 6.6	139.5 ± 4.0	23	0.004

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Method

Procedure

- The participant sits in front of a PC screen monitor
- Two preliminary sessions
 - First, participant = passive observer (5 minutes)
 - Second, participant = active attitude (no limit)
- Assessment session
 - No time limit
 - Execution of the task
- Performance review
 - Therapist with/without participant

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Method

Assessment

- Psychometric assessment
 - Global intellectual efficiency : Mattis *Mattis, 1975*
 - Exploration of executive functions: Wisconsin, Stroop, Brown-Peterson, Verbal fluency
- VR-based assessment
 - Semantic knowledge related to the task (I)
 - Information processing speed (II)
 - Temporal and spatial organization (III)

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Results

VR-based assessment

		<i>Patients (5 F, 8 M)</i>	<i>Controls (8 F, 3 M)</i>	U	p
I	Good actions	11.6 ± 0.4	12.0 ± 0.0	60.5	0.531
	Error percentage (%)	12.1 ± 12.8	8.74 ± 7.5	63.5	0.649
II	Time for first action (min)	3.30 ± 3.59	1.39 ± 0.93	24	0.005**
	Time for paying (sec)	24 ± 17	10 ± 10	36.5	0.041*
III	Distance (m)	378.1 ± 126.4	238.8 ± 57.7	18	0.001**
	Duration (min)	28.8 ± 15.4	12.8 ± 4.2	16	0.001**
	Number of stops	67.9 ± 34.8	31.8 ± 12.0	20.5	0.002**
	Number of path intersections	125 ± 131	22 ± 12	15	0.001**
★	Categorization	4.27 ± 3.24	2.45 ± 1.13	40	0.072

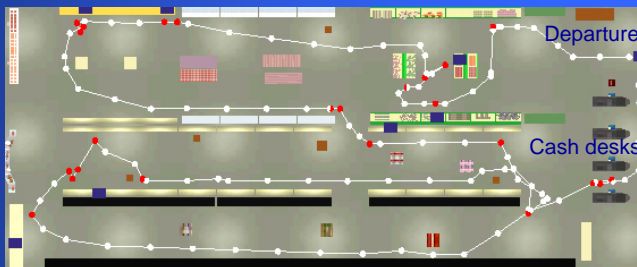
** p<0.005, non parametric test of Mann-Whitney

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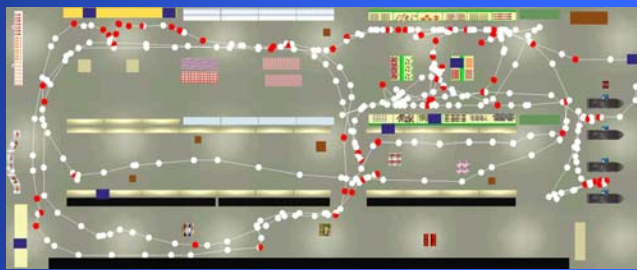
Results

Performances comparison

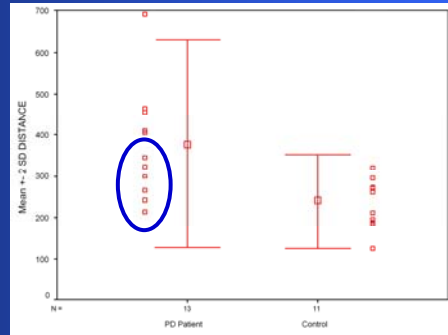
Control :
 Duration : 8 min
 Distance : 215 m
 Stops : 25



Patient with PD :
 Duration : 25 min
 Distance : 469 m
 Stops : 67



- Distance is a discriminant variable



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- Distance is a discriminant variable
- Other significant variables
 - Duration
 - Time for the first action
 - Number of path intersections

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Results

Assessments comparison

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Mattis													
WCST													
BPP													
Stroop													

Virtual Supermarket

I													
II													
III													

I: Semantic knowledge II: Speed of processing
III: Spatio-temporal organization

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Discussion

- Confirmation
 - Correct goal formulation *Zalla et al., 2000*
 - Slowing down of information processing *Rogers, 1986*
- Contribution
 - Alteration of temporal and spatial organization
 - Length and duration of the path
 - Task sequence
- Remaining questions
 - Role of spatial capacities, memory, gender, ...

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Conclusion

- **Advantages of the tool**
 - Precise measure of performances
 - Distinction Patients / Controls
 - Highlight of deficits
 - Possibilities of performance review
- **Perspectives with the Virtual Supermarket**
 - Assessment : New tasks, Other populations
 - Rehabilitation : Repetition, graduation

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And in these perspectives ...



Hebrew adaptation (Klinger, 2005)

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Thanks for your attention

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