Annual Review of Cybertherapy and Telemedicine 2014
B.K. Wiederhold and G. Riva (Eds.)
IOS Press, 2014

doi:10.3233/978-1-61499-401-5-40

Cognitive Assessment of OCD Patients: NeuroVR vs Neuropsychological Test

Filippo LA PAGLIA[a,1] Caterina LA CASCIA[a], Rosalinda RIZZO[a], Flavia CANGIALOSI[a], Margherita SANNA[a], Giuseppe RIVA[b], and Daniele LA BARBERA[a]
[a] *Department of Experimental Biomedicine and Clinical Neuroscience, University of Palermo, Italy*
[b] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy*

Abstract. This study aimed to evaluate the reliability and validity of the Neuro-Virtual Reality as tool for the neuropsychological assessment in OCD patients. We used the neuropsychological battery and a virtual version of the Multiple Errand Test (V-MET), developed using the NeuroVR software, in order to evaluate the executive functions, the ability to plan ahead on complex problem solving tasks in daily life in 30 obsessive compulsive disorder (OCD) patients and 30 healthy controls. The results showed the presence of difficulties of OCD patients: lower levels of divided attention and higher levels of errors; higher mean rank of inefficiencies, interpretation failures and rule breaks and longer time of execution of the whole task. By contrast, controls have higher level of efficiency and better performance. In addition, a significant correlation was found between the V-MET and the neuropsychological battery which confirms and supports the ecological validity of neurocognitive assessment through NeuroVirtual Reality.

Keywords. Obsessive-compulsive disorder, virtual multiple errands test, executive functions, neuropsychological assessment

Introduction

Obsessive–Compulsive Disorder (OCD) is a debilitating mental disorder characterized by recurrent, intrusive and unwanted thoughts, impulses and images that cause an increased amount of anxiety and often associated with compulsive behaviors that are repetitive, time consuming and often ritualized. Globally, neuropsychological findings are consistent with the frontostriatal etiologic hypothesis of OCD and include impairments in a variety of domains: neurocognitive deficit and executive dysfunction appears to be representative of the perseverative and repetitive behavior [1, 2]. Specifically, patients with obsessive compulsive disorder are characterized by the impairment of several skills such as attention, planning, problem-solving and behavioral control [3]. Further, OCD is often associated with impairments of visuospatial skills [4], and of memory functioning, including visual, verbal, and numerical [5]. However, the neurocognitive assessment under typical clinical laboratory condition are unsatisfactory because it presents trials independent from any activities of daily living, and for this reason lacking in ecological validity [6]. By

[1] Corresponding Author. Filippo La Paglia, Dipartimento di Biomedicina Sperimentale e Neuroscienze Cliniche, Università di Palermo, Italy. E-mail: filippolapaglia@gmail.com; filippo.lapaglia@unipa.it

contrast, the present study is aimed at evaluating the reliability and validity of the Virtual Reality as tool (able of providing an ecologically valid context) for the neuropsychological assessment in OCD patients.

For this purpose, we used neuropsychological battery and a virtual version of the Multiple Errand Test (V-MET) [2, 7, 8], developed using the NeuroVR software 2.0 [9], in order to evaluate the executive functions and the ability to plan ahead on complex problem solving tasks in daily life, in OCD patients and in healthy controls. Several studies shows that Virtual Multiple Errand Test can offer new possibilities for the assessment of executive functions providing an additional support to the traditional paper and pencil tasks [7, 8, 10, 11].

A supermarket was chosen as the virtual environment, performed in a shopping setting where there are items to be bought and information to be obtained. After the tasks and the rules have been explained, patients are able to plan and choose the sequence of actions to complete the tasks. In this way, the stimulated executive functions are numerous, from the ability to plan a sequence of actions, to problem solving and to cognitive and behavioral flexibility.

1. Methods

1.2 Participants

A total of 60 participants were included in the study: 30 patients suffering from Obsessive Compulsive Disorder diagnosed by DSM IV (M=15, F=15; mean age=33,07 years, std.dev.= 9,906) and 30 healthy controls (M=16, F=14; mean age=34,00 years, std.dev.=10,841) (table 1). Patients were selected from the Outpatient Unit of Psychiatry of Palermo University Hospital.

Table 1 Population characteristics

	Experimental group	**Control group**
	n = 30	*n* = 30
Age (Mean ± SD)	33,07 ± 9,906	34,00 ± 10,841
(range)	18 - 54	20 - 57
Gender (M, F)	15, 15	16, 14

The exclusion criteria for the clinical group were: severely impaired mental status according to neuropsychological assessment; motor impairment which does not allow subject to perform the virtual procedure; presence of severe difficulties in visual discrimination skills and language comprehension; psychiatric comorbidity. The control group consisted of healthy subjects without motor and cognitive impairments.

1.3 Instruments and Procedure

There were two methods of assessing cognitive functions: 1) using a validated neuropsychological battery and 2) using of the Virtual Multiple Errands Test (V-MET).

The neuropsychological battery including: Frontal Assessment Battery (FAB), Trail Making Test (TMT, Forms A, B and B-A), Phonemic and Semantic Fluency, Tower of London (ToL) and Memory Battery (Digit span, Corsi's memory span and supra-span, Short Story recall and word recall tests). Scores were corrected for age, education level and gender where appropriate.

After a neuropsychological evaluation, we used the Virtual Multiple Errands Test (V-MET) both in cases and in controls. In this version, after a training session in a smaller version of the virtual supermarket environment, the subjects were requested to select and to buy various products presented on shelves with the aid of a joy-pad. The products were in categories including food, hygienic products, frozen food, and on-sale products. Furthermore, while doing his shopping, the participant had to follow specific rules, i.e. not to go in the same aisle more than once, not to enter in any aisle unless the participant needs to collect something in it, do not speak to the person observing you unless this is part of the exercise.

While completing the Multiple Errands Test procedure, the time of execution, total errors, partial tasks failures, inefficiencies, rule breaks, strategies and interpretation failures were measured [7, 8].

1.4 Statistical Analyses

At baseline, groups were similar in terms of gender, age and education level.
One-way analyses of variance (ANOVAs) were used to compare patients and controls performance. Pearson Correlation was used to compare neuropsychological and VR tests.

2. Results

Neuropsychological assessment showed intact cognitive levels in OCD patients and in controls. However, the clinical sample compared to controls show a performance significantly lower, with the exception of memory trials (Short Story recall and word recall tests).

After virtual reality assessment, the ANOVAs revealed a clear presence of difficulties of OCD patients. These seem to reflect deficits in the attention function. Particularly, OCD patients showed: lower level of divided attention (F=13,531, p=0,001); higher levels of errors (F=20,894, p=0,000), higher levels of partial errors for the sub-tests 6 (buying two products from the refrigerated products aisle), (F=13,417, p=0,001) and partial errors 7 (going to the beverage aisle and asking about what to buy, (F=13,373, p=0,001), which require a change in the primary task and the ability to respond simultaneously to multiple task demands; higher mean rank of inefficiencies (F=6,407, p=0,014), interpretation failures (F=5,654, p=0,021), self correction (F=13,718, p=0,000), and longer time of execution of the whole task (F=4,069, p=0,048).

It could suggest that OCD patients tend to engage in a more extensive planning activity. By contrast, controls have higher level of divided attention and self correction, fewer interpretation failures and higher level of efficiency, so their performance is better than patient's performance.

With regard to clinical sample, *correlations* between neuropsychological tests and the variables of the virtual test are shown in Table 2.

Table 2. Pearson Correlation between neuropsychological test and VMET tests

†. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed)

	FAB		ToL		TMT A		TMT B		TMT B-A	
	r	p	r	p	r	p	r	p	r	p
Errors	-,497†	,000	-,416†	,003						
Partial errors 6	-,351*	,014	-,461†	,001	,434†	,002	,435†	,002	,389†	,006
Partial errors 7	-,593†	,000	-,512†	,000	,500†	,000	,468†	,001	,403†	,004
Inefficiencies	,437†	,002	,505†	,000	-,406†	,004	-,301*	,036		
Sustained attention	-,340*	,017			,406†	,004	,472†	,001	,438†	,002
Divided attention	-,402†	,004	-,619†	,000	,437†	,002	,448†	,001	,400†	,004
No perseveration	-,531†	,000			,358*	,011	,342*	,016	,299*	,037
Self correction	-,568†	,000	-,404†	,004	,361*	,011	,360*	,011	,316*	,027

	Corsi's memory span		Short Story		Corsi's supra-span		Semantic Fluency	
	r	p	r	p	r	p	r	p
Errors	-,282*	,050	-,342*	,016	-,540†	,000	-,463†	,001
Partial errors 6			-,392†	,005	-,543†	,000	-,352*	,013
Partial errors 7	-,286*	,046	-,331*	,020	-,464†	,001	-,346*	,015
Inefficiencies			,469†	,001	,442†	,001		
Time	-,310*	,030	-'302*	,035				
Sustained attention			-,386†	,006	-,291*	,043		
Divided attention	-,334*	,019	-,369†	,009	-,566†	,000	-,377†	,008
No perseveration	-,314*	,028	-,309*	,031	-,427†	,002		
Self correction	-,329*	,021	,341*	,017	-,561†	-000	-,421†	,003

Our results show V-MET data, about total errors, partial errors (sub test 6 and 7), inefficiencies, time of execution, sustained attention and divided attention, self correction, absence of perseveration, correlate with results of the neuropsychological battery.

Therefore, patients who showed a high test score FAB are also able to recognize their mistakes and to correct itself by changing their behavior and their strategies according to the objective to be achieved.

In addition, individuals who possess good planning skills (TOL) and memory ability put in place a more strategic behavior (i.e. using a map of the supermarket, check the instructions, using the reference points for orientation, etc.), recording consequently minor inefficiencies.

Conclusions

Results of the analyses carried out within the present study confirm previous data about OCD cognitive impairment and about ecological validity of V-MET as an instrument for the evaluation of executive functions in patients with OCD.

In particular, procedure was able to detect the cognitive difficulties that are typical of Obsessive Compulsive Disorder and specifically the deficits in planning, which is the strategy that allows the correct execution of the task, in problem solving, in divided attention and in mental flexibility. Furthermore, our study proved the presence of impaired strategic behaviour and set shifting abilities in these types of patients, when compared with matched healthy subjects.

References

[1] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders*. (Fourth ed.) American Psychiatric Pub, Washington, DC, 1994.

[2] T. Shallice & P.W. Burgess, Deficits in strategy application following frontal lobe damage in man, *Brain* **114** (1991), 727-74.1

[3] P.W. Burgess & N. Alderman, Executive dysfunction. In L.H. Goldstein & J. E. McNeil (Eds.), *Clinical neuropsychology: A practical guide to assessment and management for clinicians* (pp. 185-209), Chichester, Wiley, 2004.

[4] E. Hollander, L. Cohen, M. Richards, L. Mullen, C. De Caria, Y. Stern, A pilot study of the neuropsychology of obsessive-compulsive disorder and Parkinson's disease: basal ganglia disorders. *Journal of Neuropsychiatry and Clinical Neuroscience* **5** (1993), 104–106.

[5] J. L. Martinot, J.F. Allilaire, B.M. Mazoyer, E. Hantouche, J.D. Huret, F. Legaut-Demare, A.G. Deslauries, S. Pappata, J.C. Baron, A. Syrota, Obsessive-compulsive disorder: a clinical, neuropsychological and positron emission tomography study. *Acta Psychiatrica Scandinavica* **82** (1990), 233–242.

[6] G. Goldstein: Functional considerations in neuropsychology. In R. J. Sbordone, C. J. Long, (eds) *Ecological validity of neuropsychological testing*, pp 75-89. GR Press/St. Lucie Press, Delray Beach, Florida (1996).

[7] S. Raspelli, L. Carelli, F. Morganti, B. Poletti, B. Corra, V. Silani, G. Riva, Implementation of the Multiple Errands Test in a NeuroVR-supermarket: a Possible Approach, *Studies in Health Technology and Informatics* **154** (2010), 115-119.

[8] F. La Paglia, C. La Cascia, R. Rizzo, G. Riva, D. La Barbera, Assessment of Executive Functions in Patients with Obsessive Compulsive Disorder by Neuro VR. *Studies in Health Technology and Informatics*, **181** (2012), 98-102.

[9] G. Riva, A. Gaggioli, A. Grassi, S. Raspelli, P. Cipresso, F. Pallavicini, C. Vigna, A. Gagliati, S. Gasco, G. Donvito, NeuroVR-2 a free virtual reality platform for the assessment and treatment in behavioral health care. *Studies in Health Technology and Informatics*. **163**, (2011), 493-5.

[10] E. Pedroli, P. Cipresso, S. Serino, F. Pallavicini, G. Albani, G. Riva, Virtual multiple errands test: reliability, usability and possible applications. *Studies In Health Technology And Informatics*, **191** (2013), 38-42.

[11] P. Cipresso, F. La Paglia, C. La Cascia, G. Riva, G. Albani, D. La Barbera, Break in volition: A virtual reality study in patients with obsessive-compulsive disorder. *Experimental Brain Research*, **229**, (2013), 443-449.