

Effects Of An Online Cognitive Training Program

Marisa Fernández-Sánchez¹, Javier Sánchez¹, Juan Miguel Diago¹ & José Ignacio Bescós¹

⁽¹⁾Unobrain Neurotechnologies, S.L., Madrid, Spain

marisafernandez@unobrain.com

Introduction

Cognitive impairment has been demonstrated in patients suffering **Fibromyalgia** (FM), a chronic widespread pain syndrome, in which the neural substrate is still under study. Deficits are commonly found in complex attention, working memory, semantic and episodic memory (Glass, 2010), and patients usually comment on the severe impact that these failures have on their daily living.

The positive effects of **neuropsychological rehabilitation** programs in people with acquired brain injury have been well established in the scientific literature (Rohling et al., 2009). More recently, efforts have been made to test the impact of computerized cognitive treatments on the neuropsychological functioning of different clinical populations such as people suffering stroke (Westerberg et al., 2007) or schizophrenia (Fisher et al., 2009). However, up to the authors' knowledge there are no previous studies which test the effects of an online cognitive rehabilitation program directed to improve cognitive failures in a group of FM patients.

Methods

With the aim of exploring these questions, a total of 37 women with FM participated in our study. The total sample was divided in an experimental group (EG; N=19) and a control group (CG; N=18). Clinical and neuropsychological assessment was performed before and after a **computerized online cognitive training program** (COCTP) was conducted on the EG.

Clinical tests were the Fibromyalgia Impact Questionnaire (FIQ), Beck Depression Inventory (BDI), Attention Related Cognitive Errors Scale (ARCES), Memory Failures Scale (MFS) and other questions about medication and years of disease.

Neuropsychological evaluation included the Map Search test (MS) (Fig. 1) from the Test of Everyday Attention (TEA), the Trail Making Test (TMT), Phonetic (COWAT) and Semantic Fluency (Animals), Stroop Test (ST), and Digit Symbol (DS) and Vocabulary (V) from the Wechsler Adult Intelligence Scale III.

In the MS, the patient is asked to mark as many symbols as possible equal to a given example.



Figure 1. Map Search subtest from the TEA

The COCTP, designed by **Unobrain** Neurotechnologies, had a duration of 11 weeks and included a total of 12 computer games (Table 1). Each of them was repeated 8 times along the program span. The participants in the EG were asked to practice three times per week, with every session including three different games (15 minutes approximately).



Figure 2.
Runas



Figure 3.
Palabras
escondidas

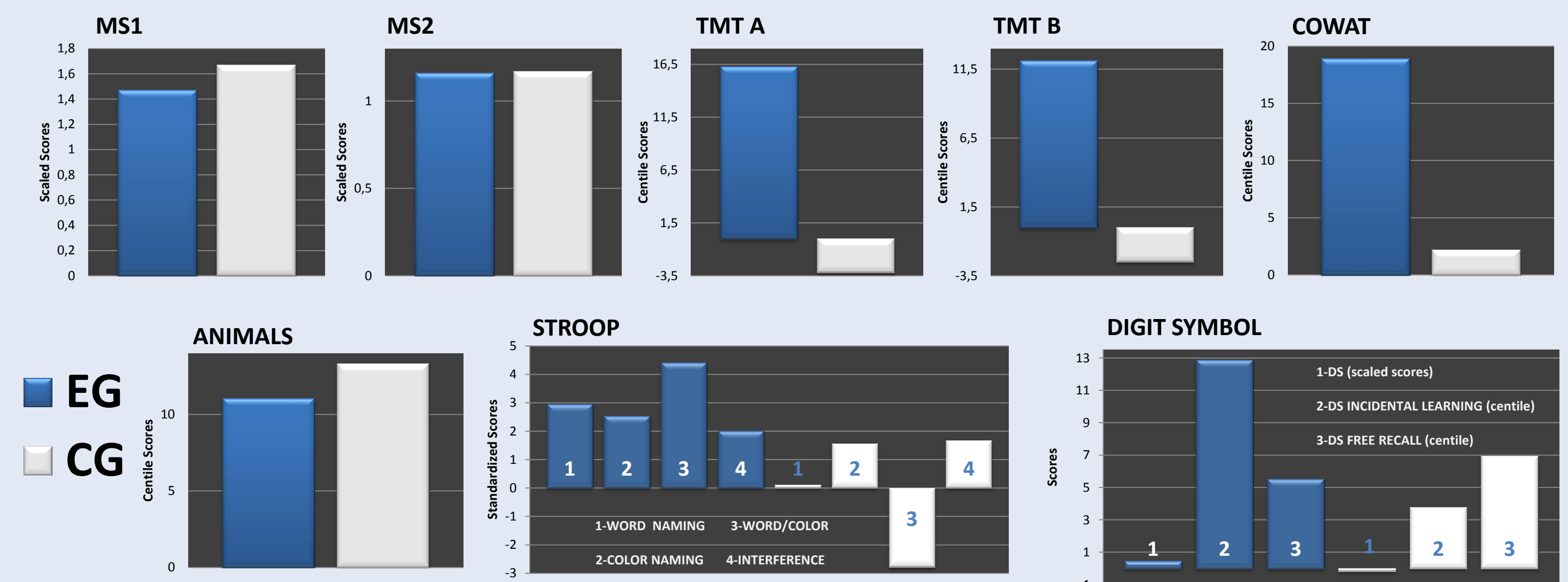
Game Name	Game Description
Cazahuevos	A divided attention task where it is required to click on eggs of different colors while eliminating red eagles that appear on the screen at the same time.
Inmersión	An auditory working memory exercise in which the location of a submarine is determined by the number of specific tones that must be carefully listened to.
Runas	A selective attention and visual search game where a symbol must be found among other similar ones (Fig. 2)
Perdido en la charca	A task of visual learning and memory. The player must discover and remember the correct sequence of steps to get to the end of the row.
Boom	With the shape of a changing labyrinth the player must find the way to disconnect a bomb, testing his executive functions.
Palabrejas	An increasing number of bees appear on the screen carrying words to be read, learned and remembered, a traditional verbal memory task.
Ying-Yang	Rotating figures must be matched as fast as possible in this game of visual perception and speed of mental processing.
Postales del mundo	An episodic memory task where 7 differences must be found between a picture and its incomplete copy presented after it.
Abre la caja	A short-term memory game where growing sequences of colors and sounds need to be repeated by the player.
Matematicars	Oriented to work arithmetic calculations which will make our race car win the competition.
Lluvia de cajas	A space perception task where a number of boxes is to be counted taking into account the perspective.
Palabras escondidas	With a number of different given letters the subject is asked to form as many words as possible in a time given, testing his verbal fluency (Fig. 3)

Table 1. Description of computer games included in the COCTP

Results

The statistical analysis did not show significant differences between groups in the pre-program assessment in any of the sociodemographical variables, nor in the clinical or neuropsychological measures ($p < .05$) excepting higher scores for the CG in the COWAT ($z = -2.543$; $p < .05$). Post-intervention scores' analysis showed significant differences only in the DS (free recall) test ($z = -2.077$; $p < .05$) with the CG performing slightly better than EG.

A Wilcoxon Test of related samples showed significant differences between the two conditions for the EG in the MS, TMTA, COWAT, Animals, Stroop Color Naming, Stroop Word Color score and all DS tests. In the CG only the MS test reached significance.



Figures 4 to 11. Mean contrasts between differential scores in neuropsychological tests.

A mean contrast between differential scores revealed significant higher differences for the EG in the TMTA ($z=-2,592$; $p=.01$), COWAT ($z=-2,350$; $p<.05$) and the Stroop Word Color Condition ($z=-2,336$; $p<.05$). A tendency to the significance was observed also for the TMTB and the DS (Figures 4 to 11).

Conclusions

In our experiment we found that FM patients are able to improve their selective attention, verbal fluency and speed of mental processing after a brief online cognitive intervention. Our results are in the line of other that support the positive effects of cognitive training in people with neuropsychological dysfunctions. Different computerized cognitive programs have shown benefits in healthy people (Ackerman et al., 2010), malaria survivors (Bangirana et al., 2009) or Alzheimer disease (Tárraga et al., 2006). Nevertheless, new efforts should be done to shed some light to the neuropsychological rehabilitation of FM patients that would improve their quality of life.

References

- Ackerman PL, Kanfer R, Calderwood C: **Use it or lose it? Wii brain exercise practice and reading for domain knowledge.** *Psychology and Aging*, 2010, **25** (4): 753-766
- Bangirana P, Giordani B, Chandu CJ, Page C, Opoka RO, Bolvin MJ: **Immediate neuropsychological and behavioral benefits of computerized cognitive rehabilitation in Ugandan pediatric cerebral malaria survivors.** *Journal of Developmental & Behavioral Pediatrics*, 2009, **30** (4): 310-318
- Fisher M, Holland C, Merzenich MM, Vinogradov S: **Using neuroplasticity-based auditory training to improve verbal memory in schizophrenia.** *American Journal of Psychiatry*, 2009, **166** (7): 805-811
- Glass JM: **Cognitive dysfunction in fibromyalgia syndrome.** *Journal of Musculoskeletal Pain*, 2010, **18** (4): 376-372
- Rohling ML, Faust ME, Brenda B, Demakis G: **Effectiveness of cognitive rehabilitation following acquired brain injury: A meta-analytic re-examination of Cicerone et al.'s (2000, 2005) systematic reviews.** *Neuropsychology*, 2009, **23**(1): 20-39
- Tarraga L, Boada M, Modinos G, Espinosa A, Diego S, Morera A, Guitart M, Balcells J, López OL, Becker JT: **A randomized pilot study to assess the efficacy of an interactive, multimedia tool of cognitive stimulation in Alzheimer's disease.** *Journal of Neurology, Neurosurgery and Psychiatry*, 2006, **77**: 1116-1121
- Westerberg H, Jacobaeus H, Hirvikoski T, Clevberger P, Östenson ML, Bartfai A, Klingberg T: **Computerized working memory training after stroke-A pilot study.** *Brain Injury*, 2007, **21** (1): 21-29