The Effectiveness of a Training Programme in Obsessive-Compulsive Patients' Behavioral Inhibition: Improving Emotional Working Memory

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ABSTRACT

Our objective was to assess the impact of a two-year emotional working memory program on behavioral inhibition of obsessive-compulsive patients. Ninety-seven obsessive-compulsive patients, 40-80 years old, were in the Emotional Working Memory (EWM) group (n=57) and the Usual Tutorial (UT) group (n=40) with four evaluation moments. Intervention focused on emotional working memory and aimed to improve behavioral inhibition by Emotional Working Memory Training software. The results revealed the beneficial effects of emotional working memory training program, which improved in obsessive-compulsive patients. These findings suggest that behavioral inhibition can be improved.

Key Words: Behavioral Inhibition, Obsessive-Compulsive Patients, Emotional Working Memory

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Introduction

Obsessive-compulsive disorder is the most serious disorder characterized by disturbing thoughts and repetitive behaviors, affecting about 2-3% of the general population (Fontenelle *et al*., 2006). Studies on the prevalence, age onset, symptoms and comorbidities of obsessive-compulsive disorder in adults in several countries showed that the annual prevalence of this disorder is between 1% and 8% (Eshun and Gurung, 2009). In this disorder, disturbing or unwanted thoughts or images cause anxiety, and repeated behaviors and subjective actions are performed to reduce unpleasant feelings. In other words, people with obsessive-compulsive disorder face difficulties in suppressing some thoughts and actions (Penades *et al*., 2007; Gao 2017). Due to abnormalities in the Fronto-striatal circuits, executive functions have always been discussed in this disorder, and a number of deficiencies have been reported in the inhibition control of behavior and neural communication.

Behavioral inhibition is a neuro-cognitive process that helps children for a delay respond (Barkley, 1997b). Poor behavioral inhibition can be associated with a deficit in controlling potential responses, especially forced behaviors (White *et al*., 2011; Xiaoxu *et al*., 2017; Peng 2017). Many studies found the inability of behavioral inhibition in people with obsessive-compulsive disorder (Coles *et al*., 2006; Morein-Zamir *et al*., 2010; Shahamat *et al*., 2016; Lei *et al*., 2015; Gao 2017; Gao 2017).

Lipszyc and Schachar (2010) in a meta-analysis study showed that inhibition deficits levels among patients with obsessive-compulsive disorder are higher compared with other disorders such as tort syndrome or anxiety and mood disorders.

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Recent studies on motor inhibition in obsessive-compulsive patients using the go/no-go paradigm showed the negative relationship between symptoms severity and go/no-go task performance (Lei *et al*., 2015; Van Velzen *et al*., 2014; Romas 2016).

Some studies showed that working memory tasks performance among patients with obsessive-compulsive disorder is lower compared with healthy people (Zitterl *et al*., 2001; Kohli *et al*., 2015; De Geus *et al*., 2007; Lin,2017). On the other hand, some studies have shown the relationship between inhibition and working memory (Booth, Boyle & Kelly, 2014; Traverso *et al*., 2015; McCabe *et al*., 2010; Peng 2017). The study of Redick *et al*. (2011) shows, in the go/no-go task, lower performance of participants with low working memory capacity compared with participants with high working memory capacity.

Working memory capacity might be antecedents in inhibitory processes that lead to better behavioral inhibition and consequently better well-being and performance (Redick *et al*., 2007; Wang, 2017). Emotional working memory strategies might be helpful to foster such inhibitory processes. Some studies described the importance of inhibitory processes (Simpson *et al*., 2012; Thayer, 2006). Emotional working memory strategies might function as a kind of coping strategy to help patients with obsessive-compulsive disorder to increase to working memory capacity. As a consequence, working memory capacity should result in higher levels of executive functions, preventing patients with obsessive-compulsive disorder from some negative long-term effects.

Based on the evidence proposed, this study evaluates the effectiveness of a behavior-based emotional working memory program in patients with obsessive-compulsive, developed by Schweizer and Dalgleish (2011). Emotional working memory refers to short-term memory function in encrypting, maintaining, manipulating and retrieving emotional information. Schweizer *et al*. (2013) described emotional working memory as the ability to identify, understand and adjust emotions. While working memory has a fixed structure, training with higher changeability and effectiveness can be hoped by an ability to strengthen working memory in the emotional tissue (Morrison and Chein, 2011). Therefore, the main characteristic of emotional work memory training is that it will lead to significant improvements in the person by constantly training this task in the memory processes associated with emotional disorders (Joormann, Levens & Gotlib, 2011).

Thus, the contribution of this study is threefold: (a) we want to focus on all the behavioral inhibition dimensions, based on the Hoffman model (commitment error and omission error, reaction time), rather than on only one specific component of behavioral inhibition, (b) we want to use a quasi-experimental design with assignment to an EWM group or UT group in order to examine EWM training program effects, (c) we want to compare the effects of one EWM training program year and the effects of two EWM training program years.

The aim of this study is to test the effectiveness of a two-year EWM training program on the different behavioral inhibition dimensions among patients with obsessive-compulsive disorder. We hypothesized that:

A) The EWM training program will improve patients' behavioral inhibition dimensions;

B) The effects of this EWM training program will be present after 6 months;

C) A second EWM training program year will further improve the behavioral inhibition dimensions.

2. Methods

2.1. Participants

An experimental study with two-group, pretest-posttest, and two-year follow-up was conducted in two psychiatry clinics in the province of Jiangsu (China). One of these clinics served as EWM intervention site and the other served as matched control based on psychiatric disorders treatment information reports. Patients with obsessive-compulsive disorder were excluded from the study if they were diagnosed with learning disabilities (dyscalculia, dyslexia and dysgraphia) or if they were immigrants from other countries. This study was approved by a trained psychologist at Jiangsu Normal University.

Data were collected on a total of 97 patients with obsessive-compulsive disorder (see Table. 1). The EWM group consisted of 57 patients, 35 males (61.4%) and 22 females (38.6%). The UT group consisted of 40 patients, 25 males (62.5%) and 15 females (37.5%). There were no significant between-group differences concerning age (EWM group: M= 31.83, SD = 1.67; UT group: M= 32.05, SD = 1.30) and gender (EWM group: 61.4% male and 38.6% female; UT group: 62.5% male and 37.5% female). With

regard to disease types, 38% (n = 37) had cardiovascular disease (CVD), 34% (n = 33) diabetes mellitus (DM) and 28% (n = 27) osteoporosis (OP).

We assessed the patients at four points in time: pretest (time 1), at the end of the first EWM training program year (time 2), at the beginning of the second EWM training program year (time 3), and after the second EWM training program year (time 4).

2.2. Measure

For our sample of patients with obsessive-compulsive disorder, who have to face disturbing thoughts and repetitive behaviors, we expected growing obsessive-compulsive disorder during the quenching of some thoughts and deeds (Morein-Zamir *et al*., 2010; Lei *et al*., 2015). We used the scales time spent, interference rate, discomfort rate, resistance rate and control rate of the Yale-brown obsessive-compulsive scale (YOCS) (SR-YBOCS; Baer, 1991; Goodman and Price, 1989).

The scales commitment error, omission error and reaction time were assessed using the go/no-go test as indicators of executive functions (Wodka *et al*., 2007). The test is a 2-signal measure. Participants should respond to a set of incentives (go) and refrain from responding to other categories (no-go). As the number of go sub-signals is usually higher than no-go sub-signals, ready to provide answers in people is more (Verbruggen and Logan, 2008).

2.3. Intervention design

The EWM program was implemented by a trained psychologist group, including four psychologists, in a psychiatry clinic in Jiangsu. The EWM program was carried out during 2 treatment courses. In each treatment year, the EWM program sessions took place for 2 days a week for 25–30 min/day over 26 weeks, for each treatment year. Each week focused on a specific theoretical knowledge about working memory skills. Our EWM program's design was based on Schweizer's protocol described software (Schweizer *et al*., 2013). This software includes an emotional backward computer task that simultaneously presented an image for 500 milliseconds on a 4×4 matrix in the monitor and a word for 500 milliseconds in the headphone. An image-word pair was followed by a 250 millisecond interval that the participants responded to one or both signals simultaneously by pressing the button. 60% of the words (e.g. rape and death) and images (e.g. fear, sadness, and anger) reflect a negative excitement, and the rest (e.g. wardrobe and chair) are emotionally neutral. The task had audio and video feedback.

2.4. Procedure

The patients with obsessive-compulsive disorder completed testing at all four assessment periods: (a) pretest (first test), before the first EWM training program, (b) second test, at the end of the first EWM training program year, (c) third test, at the beginning of the second EWM training program year, and (d) fourth test, after the second EWM training program year. At before the training, all the patients were informed about the procedure and the treatment of their data. The patients with obsessive-compulsive disorder in the EWM group attended all the sessions held in the two treatment years. They learned and practiced the strategies mentioned above during two years, while the patients in the UT group learned something about how to develop training courses and completed the same measures at the same time as the EWM group.

3. Results

We compared the EWM and UT groups in ANOVA with training (intervention/control) × time (first test, second test, third test, forth test) on time spent, interference, discomfort, resistance, control, commitment error, omission error and reaction time. Table 2 shows the average scores and standard deviations of the EWM and UT groups. As can be seen, we observed a significant training-time interaction for the time spent ($F(3,224) = 3.27$, $p < 0.001$, partial $\eta^2 = 0.02$), interference rate ($F(3,224) = 2.96$, $p < 0.001$, partial $\eta^2 = 0.04$), discomfort rate ($F(3,224) = 4.51.27$, $p < 0.001$, partial $\eta^2 = 0.01$), resistance rate ($F(3,224) = 6.72$, $p < 0.001$, partial $\eta^2 = 0.05$), control rate ($F(3,224) = 3.49$, $p < 0.001$, partial $\eta^2 = 0.03$), commitment error ($F(3,224) = 2.83$, $p < 0.001$, partial $\eta^2 = 0.06$), omission error ($F(3,224) = 7.16$, $p < 0.001$, partial $\eta^2 = 0.02$) and reaction time ($F(3,224) = 6.83$, $p < 0.001$, partial $\eta^2 = 0.04$) dimensions.

Table 3 shows the reported simple effects between EWM and UT groups resulted due to the homogeneity of the EWM and UT groups before the EWM training program. While we found significant differences between EWM and UT groups on second test, third test and forth test scores, no differences were found on first test. In fourth test, partial η^2 was large for discomfort, control and commitment error, and moderate for

time spent, interference, resistance, omission error and reaction time.

For the dimension time spent, a significant decrease was observed in the EWM group (M= 15.43, SD = 5.12 at first test, M= 15.10, SD = 3.46 at second test, M= 15.11, SD = 3.11 at third test, and M= 14.03, SD = 3.25 at fourth test). In the EWM group, there was a significant decrease in the scores from first test to second test (mean difference = 0.33, $p < 0.001$), from first test to third test (mean difference = 0.32, $p < 0.001$), from first test to fourth test (mean difference = 1.40, $p < 0.001$), from second test to fourth test (mean difference = 1.07, $p < 0.001$), and from third test to fourth test (mean difference = 1.08, $p < 0.001$). In the UT group, we observed a significant increase (M= 15.23, SD = 4.16 at first test, M= 15.19, SD = 4.11 at second test, M= 15.51, SD = 3.72 at third test, and M= 15.32, SD = 3.78 at fourth test).

For this dimension, we observed a significant decrease in the EWM group (M= 20.64, SD = 2.73 at first test, M= 19.26, SD = 2.46 at second test, M= 19.84, SD = 3.16 at third test, and M= 17.01, SD = 4.44 at fourth test).

Table 1. Sample composition

Patients characteristic		Total (97 patients)	Frequency	
			EWM group (57 patients)	UT group (40 patients)
Age		31.94 (SD = 0.38)	31.83 (SD = 1.67)	32.05 (SD = 1.30)
Gender	Male	n = 60	35 (61.4%)	25 (62.5%)
	Female	n = 37	22 (38.6%)	15 (37.5%)
Disease types	CVD	n = 37 (38%)	n = 17 (29.8%)	n = 20 (50%)
	DM	n = 33 (34%)	n = 18 (31.5%)	n = 15 (37.5%)
	OP	n = 27 (28%)	n = 13 (22.8%)	n = 14 (35%)

Table 2. Interaction effects between EWM and UT group

	F	Partial η^2	Group	First test	Second test	Third test	Fourth test
Time spent	3.27*	0.02	UT	15.23 (4.16)	15.19 (4.11)	15.51 (3.72)	15.32 (3.78)
			EWM	15.43 (5.12)	15.10 (3.46)	15.11 (3.11)	14.03 (3.25)
Interference	2.96**	0.04	UT	20.16 (3.46)	20.25 (3.16)	20.42 (3.01)	20.18 (3.10)
			EWM	20.64 (2.73)	19.26 (2.46)	19.84 (3.16)	17.01 (4.44)
Discomfort	4.51*	0.01	UT	16.34 (4.29)	16.25 (4.12)	16.54 (4.19)	15.51 (4.10)
			EWM	16.55 (3.11)	16.11 (5.23)	16.19 (4.87)	14.08 (3.43)
Resistance	6.72*	0.05	UT	26.44 (6.11)	26.55 (5.73)	26.36 (5.55)	28.40 (5.45)
			EWM	26.32 (5.33)	25.46 (5.12)	25.51 (6.32)	24.14 (5.71)
Control	3.49*	0.03	UT	26.11 (4.79)	26.27 (4.56)	26.22 (4.09)	26.31 (4.21)
			EWM	26.28 (3.46)	25.72 (3.22)	25.81 (3.47)	24.75 (3.61)
Commitment error	2.83**	0.06	UT	29.23 (5.43)	29.15 (5.26)	29.33 (5.11)	29.41 (5.12)
			EWM	29.10 (6.22)	28.41 (6.11)	28.52 (6.03)	27.28 (5.31)
Omission error	7.16*	0.02	UT	25.16 (6.34)	25.28 (6.13)	25.23 (5.77)	25.21 (5.67)
			EWM	25.34 (5.48)	24.16 (5.72)	24.33 (5.11)	23.34 (5.34)
Reaction time	6.83**	0.04	UT	24.12 (3.28)	24.07 (3.27)	24.18 (3.11)	24.15 (3.13)
			EWM	24.36 (4.26)	24.02 (4.71)	24.11 (4.33)	23.41 (4.82)

Table 3. Simple effects between EWM and UT groups on first test, second test, third test, and fourth test scores.

	First test				Second test				Third test				Fourth test			
	F	df	ρ	η^2	F	df	ρ	η^2	F	df	ρ	η^2	F	df	ρ	η^2
Time spent	17.33	1/95	0.721	0.00	8.16	1/95	0.015	0.05	7.18	1/95	0.000	0.04	1.06	1/95	0.000	0.06
Interference	23.14	1/95	0.616	0.00	10.31	1/95	0.000	0.00	9.51	1/95	0.000	0.00	2.43	1/95	0.000	0.07
Discomfort	15.64	1/95	0.791	0.00	6.73	1/95	0.026	0.06	6.52	1/95	0.001	0.08	0.19	1/95	0.000	0.15
Resistance	22.24	1/95	0.495	0.00	9.46	1/95	0.071	0.00	9.33	1/95	0.002	0.00	3.11	1/95	0.000	0.09
Control	17.94	1/95	0.673	0.00	12.25	1/95	0.016	0.08	10.31	1/95	0.001	0.07	3.55	1/95	0.000	0.14
Commitment error	24.18	1/95	0.349	0.00	15.34	1/95	0.000	0.05	15.61	1/95	0.000	0.10	4.33	1/95	0.000	0.21
Omission error	18.44	1/95	0.431	0.00	7.54	1/95	0.000	0.02	7.11	1/95	0.000	0.03	1.07	1/95	0.000	0.09
Reaction time	12.17	1/95	0.713	0.00	4.41	1/95	0.164	0.04	4.32	1/95	0.003	0.09	0.07	1/95	0.000	0.11

In the EWM group, there was a significant decrease in the scores from first test to second test (mean difference = 1.38, $p < 0.001$), from first test to third test (mean difference = 0.80, $p < 0.001$), from first test to fourth test (mean difference = 3.63, $p < 0.001$), from second test to fourth test (mean difference = 2.25, $p < 0.001$), and from third test to fourth test (mean difference = 2.83, $p < 0.001$). In the UT group, we observed a significant increase (M= 20.16, SD = 3.46 at first test, M= 20.25, SD = 3.16 at second test, M= 20.42, SD = 3.01 at third test, and M= 20.18, SD = 3.10 at fourth test).

For the other dimensions, a significant decrease was observed in the EWM group over time (first test–fourth test).

Discussion

The purpose of this experimental intervention study is to test the effects of a two-year EWM training program designed to improve behavioral inhibition in patients with obsessive-compulsive. The contribution of this study highlights that the EWM training program can protect the patients from an increase in the dimensions of this study in the long term, and our results support this hypotheses.

As expected, the EWM training program improved time spent, interference rate, discomfort rate, resistance rate, control rate, commitment error, omission error and reaction time in the first year. This decrease remained stable at the end of the first EWM training program year. Furthermore, these dimensions improved after the second EWM training program year. In the UT group, none of the dimensions changed over time. While a second EWM training program year significantly improved all the dimensions time spent, interference rate, discomfort rate, resistance rate, control rate, commitment error, omission error and reaction time with regard to the improvement observed after the first EWM training program year, these dimensions without EWM training increased significantly over time, indicating the need for a specific EWM training program for these dimensions. Our results confirm previous studies about the positive relationship between working memory capacity and inhibition tasks function (Kane and Engle, 2003; Marcovitch, Boseovski & Knapp, 2007). Regarding the effectiveness of emotional working memory training on executive actions ability, our study is consistent with the results of Schweizer *et al*. (2013) and Krause-Utz *et al*. (2014).

Thus, our first hypothesis could be partially supported. As expected, the first EWM training program year improved the dimensions of this study (hypothesis 1). As further hypothesized, all the changes remained stable after the first EWM training program year (hypothesis 2). With respect to the third hypothesis, the long-term EWM training program allows patients with obsessive-compulsive disorder to continue to improve behavioral inhibition.

Although popular literature on EWM strategies is increasing year by year, it breaks new ground, especially by conceptualizing behavioral inhibition. Our study suggests that a clinic-based EWM training program might improve behavioral inhibition in patients with obsessive-compulsive disorder, and it highlights the need for long-term EWM training programs in order to maximize the effects.

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