

The Effectiveness of Cognitive Training based on Remote Associations on Improving Cognitive Function: Attention of Patients with Obsessive-Compulsive Disorder

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Abstract

Introduction: The aim of this study was to investigate the effectiveness of cognitive training based on remote associations on attention in patients with Obsessive-Compulsive Disorder (OCD).

Method: This is a quasi-experimental, single-baseline A.B.A. Three adults (28-year-old male, unmarried; 30-year-old female, married; 30-year-old male, married) with OCD who referred to the Brain and Cognition Clinic in Tehran in 2023 were selected using available sampling method. The Yale-Brown scale and Continuous Performance Task (CPT) were answered in several stages including pre-test, post-test 1-3 (with 5 days between), and follow-up (one month after post-test 3). In training sessions, the participants were asked to do cognitive training based on remote associations for 15 days. A set of 180 Persian words with moderate emotional loads were used. When seeing each word (12 words every day), the participants must have said the first three words or concepts which came to their mind, and had to write the relationship of those words to the main word. The results were demonstrated by graphs and improved effectiveness percentage.

Results: Graphic analyzes were used, as well as the effect size. The results indicated that cognitive training based on remote associations was effective in reducing obsessions and improving attention in OCD. The error rate and reaction time in the CPT were significantly reduced, and it can be said that the participants' sustained attention improved after the aforementioned training.

Conclusion: It could be stated that cognitive training programs that include remote association training along with other intervention methods might be useful in improving cognitive performance specifically sustained attention in patients with OCD.

Keywords: Cognitive Training, Association, Attention, Obsessive-Compulsive Disorder

Introduction

Establishing normative social interactions, effectively facing adversities, and the ability to solve problems in the face of multiple challenges can be considered as significant outcomes of mental health. Mental disorders are varied, and one of them is Obsessive-Compulsive Disorder (OCD). According to the evidence from various studies in the fields of pathology and treatment of OCD, the problems in the thinking process, which are the main characteristics of many people with the mentioned disorder, overshadow the information processing and impair executive and cognitive functions. Efforts to improve and enhance the cognitive functioning of these patients may help in treating the disorder and lead to an increase in their quality of life [1].

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), 22 categories of mental disorders are organized to cover the entire lifespan, from birth to death [2]. It is estimated that the prevalence of OCD in the general population is around 2-3% [3]. Research findings indicate a prevalence rate of approximately 1.8% for this disorder in the Iranian population [4].

OCD is distinguished from other disorders by symptoms such as disturbing thoughts, images, and desires. A person with this disorder engages in behaviors aimed at reducing distress or preventing feared outcomes, which significantly impairs the individual's functioning. According to the most recent edition of the DSM (DSM-5-TR), the primary feature of this disorder is the presence of obsessions. It is important to note that compulsive behaviors may also accompany the obsessions. In other words, obsessions are recurring, intrusive thoughts, desires, or images that compel individuals to engage in certain behaviors in response, which in turn have consequences across various aspects of their lives. Neurocognitive evidence from studies on patients with OCD suggests that obsessive symptoms can emerge after brain injuries [5]. Some neuropsychological studies have indicated that individuals with OCD exhibit deficits in information processing and executive functions. Executive functions refer to processes related to planning and attention control. Among these deficits, problems with visual memory, visual attention, short-term spatial memory, and spatial recognition have been observed [4]. Based on research evidence in the field of cognitive distortion, it is likely that individuals with OCD suffer from a type of information processing deficiency [6].

Among the various cognitive dimensions, attention is one of the most crucial executive functions, enabling individuals to perceive and process internal and external stimuli. Moreover, the attention process plays a key role in many higher-level cognitive functions, including reasoning and problem-solving [7]. Maintaining a moderate level of attention is essential for many everyday tasks. Attention disturbances are common in several psychiatric disorders, including OCD. Rumination is a prominent feature of OCD, significantly affecting attention and mental functioning in affected individuals. Rumination refers to the repetitive review and inability to stop intrusive thoughts and mental images, which leads to anxiety and psychological tension. Numerous studies indicate that patients with OCD suffer from impaired sustained attention [8]. Attention is a key component of executive functions, and impairment in it can disrupt the natural process of recall and slow down information processing speed. Such impairments can affect memory efficiency and reduce the effectiveness of information processing [9]. According to research, cognitive functions are affected by OCD, and the severity of cognitive dysfunction worsens as the disorder intensifies [10]. Furthermore, individuals with OCD show lower performance in memory and attention tasks compared to healthy individuals [11]. To cope with rumination and its associated harms, various therapeutic methods have been developed that can improve attention and reduce rumination.

Alongside pharmacological treatments, there are other therapeutic methods aimed at improving cognitive functioning in OCD, including transcranial direct current stimulation [12] and cognitive rehabilitation. A significant body of scientific evidence suggests that cognitive-training activities have a considerable impact on

improving cognitive performance [13-16]. Evidence suggests that cognitive rehabilitation has a significant impact on improving cognitive function, such as working memory, information processing speed, and attention and concentration [12, 17]. This approach also improves attentional performance and obsessive symptoms in people with OCD [12, 18]. One potential approach for enhancing cognitive functions is rehabilitation and training based on remote associations [19].

Research has shown that a positive mood can help improve associative memory [20]. Conversely, the relationship can also be bidirectional: broad associations of words can enhance mood [19]. The primary advantage of activating remote associations in relation to mood is that it helps divert the thinking process and prevents fixation on negative and limited topics, thereby reducing rumination. Remote association assists thought processes in gradually transitioning from one context to another, which can contribute to gaining a broader perspective on issues [20]. This approach can replace rumination, which leads to repetitive and narrow thinking, and gradually reinforce positive mental habits [21]. The particular importance of this disorder lies in its widespread nature and high prevalence rate, making it one of the most common mental disorders.

Cognitive training based on remote associations in this study, aimed at strengthening executive functions and improving attention. By relying on remote associations, this method can stimulate neural networks in the brain, helping patients become more resilient to obsessive thoughts while simultaneously enhancing their ability to manage and control these thoughts [19, 22]. Additionally, since OCD is often associated with difficulties in attention management and executive control, the use of such cognitive training may directly reduce the severity of symptoms and improve the quality of life for these patients.

Given that cognitive training based on remote associations uses words and people are not too involved in solving difficult problems, and there is no right or wrong answer, and whatever comes to mind can be the right answer, people can easily use these trainings. This method does not require the use of complex tools or methods, and a person can perform the training while going about their daily lives. Therefore, given the widespread nature of OCD, especially the cognitive dysfunctions associated with it and the need for interventions to address these impairments, this study investigates the effectiveness of cognitive training based on remote associations in improving the symptoms and attention of patients with OCD. Two main hypotheses are tested in this research: 1- Cognitive training based on remote associations is effective in reducing obsessive thoughts in patients with OCD. 2- Cognitive training based on remote associations is effective in improving the sustained attention performance of patients with OCD.

Method

The method of this study was quasi-experimental with a single-baseline ABA design. The statistical population of

this study consisted of adults with OCD who visited the Brain and Cognition Clinic in Tehran in 2023. Due to limitations in accessing all individuals and the inability to perform random sampling, convenience sampling was used. Ultimately, three individuals who met the DSM-5 diagnostic criteria for OCD and were diagnosed by a psychiatrist, participated in this study after providing a written informed consent. The participants were selected based on the inclusion and exclusion criteria for the study. The inclusion criteria were as follows: meeting the diagnostic criteria for OCD according to DSM-5 as diagnosed by a psychiatrist, completing the Yale-Brown Obsessive Compulsive Scale (Y-BOCS), being aged between 20 and 30 years, having at least a high school diploma, attending an orientation session, and providing informed consent to participate in the research, with no ongoing pharmacological or other therapeutic interventions. The exclusion criterion was the unwillingness to perform the training regularly during the intervention phase of the study.

The data were analyzed by comparing the baseline behavior rate with the treatment phase, Cohen's effect size, and the percentage of improvement, and SPSS version 22 was used to analyze the data. Effect size estimates the magnitude of an effect or relationship between one or more variables, and is resistant to sample size effects, thus providing a more accurate measure of the significance of an effect between variables. According to Cohen's D index, the effect sizes are interpreted as follows: 0 indicates no effect, 0.2 indicates a small effect, 0.5 indicates a medium effect, and 0.8 or above indicates a large effect [23].

Three individuals diagnosed with OCD participated in this study: Participant 1: A 28-year-old male, single, Participant 2: A 30-year-old female, married, Participant 3: A 30-year-old male, married, all of whom had an associate's degree of university study. All participants attended all the assessment and training sessions.

The tools used in this study were as follows:

The Yale-Brown Obsessive Compulsive Scale (Y-BOCS): The Y-BOCS is a reliable tool for assessing the severity of OCD, particularly in evaluating and tracking symptom changes over the course of various treatments. This semi-structured interview assesses the severity of obsessions and compulsions, without regard to the number and content of current symptoms. The scale is highly sensitive to treatment changes and is widely used to evaluate the effectiveness of both pharmacological and psychological treatments for OCD. Developed in 1989 by Rapoport et al., it has become a standard measure for assessing the severity of OCD [24]. In a previous study [25] involving 54 OCD patients, the internal consistency was found to be acceptable ($\alpha = 0.69$). The inter-rater reliability was excellent, and it showed good convergent validity with other OCD-related scales, though its discriminant validity was weaker when compared to depression-related scales. In Iran, the Persian version of the scale demonstrated high internal consistency, satisfactory test-retest reliability, and has proven accurate in assessing OCD patients [26].

Continuous Performance Test (CPT): The Continuous Performance Test (CPT), developed in 1956 by Rosvold et al., is a key tool for assessing attention and cognitive processing. Initially used for evaluating brain damage, it has evolved to measure the ability to sustain attention, respond to stimuli, and maintain continuous focus. The CPT includes several versions for different therapeutic and research purposes. In this test, participants must focus on a series of simple visual stimuli (e.g., Latin letters) and respond quickly when a target stimulus appears. Each trial includes 150 stimuli, 20% of which are target stimuli, with a 200-millisecond display time and a one-second interval between stimuli. The test is conducted in a quiet environment with optimal conditions, including a practice phase before the main test. Scoring involves tracking omission errors (failure to respond to target stimuli), commission errors (responding to non-target stimuli), correct responses, and reaction time. Omission errors are indicative of inattention, while commission errors reflect impulsivity. The reliability coefficients of the CPT range from 0.59 to 0.93, and its criterion validity has been reported as appropriate [27].

Following research models, appropriate words were selected in Persian for the creation of remote associations. These words were chosen based on having a moderate emotional load [6] and their key feature was that they generated the most diverse responses among a group of 200 healthy individuals. The participants were asked to state the first word or concept that came to mind upon hearing a given word. In the present study, 180 words from this group were selected for use.

The participants were instructed to write down the first, second, and third words that came to their mind upon hearing each word, and to compose one or two sentences explaining the connection between the original word and the words they had mentioned. This task was designed to engage participants more deeply with the different concepts that came to mind.

After a diagnostic interview conducted by a psychiatrist, confirming the diagnosis of OCD, the selected individuals were referred to the researcher and, after obtaining informed consent, participated in the study. The intervention process was carried out individually for each participant. In the baseline phase, participants completed the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) and the Continuous Performance Test (CPT). The intervention included cognitive training based on remote associations, which were administered over 15 sessions within a three-week period. The pre-test, post-test 1–3, and follow-up sessions each lasted approximately 45 minutes, while the association exercises took about 15 to 20 minutes. After every five training sessions, participants completed the CPT. In other words, the attention test was administered during the baseline phase and after the first, second, and third post-test sessions, as well as during the follow-up phase. The Y-BOCS was administered only during the baseline, post-intervention, and follow-up phases.

Table 2 summarizes the timeline and sequence of the intervention process, which includes the pre-test,

exercises, post-tests, and follow-up stages. The main tools used during each stage include the Y-BOCS and the CPT.

Results

Findings related to the test of the first hypothesis: Cognitive training based on remote associations is effective in reducing obsessive thoughts in patients with OCD which have been presented in Table 2.

The results of testing the first hypothesis showed that cognitive training based on remote associations led to a decrease in obsessive-compulsive scores in post-test 3 in the third week ($d=4.04$), and ($d=9.81$) in the pre-test and follow-up test.

The obtained d is large enough to confirm the first hypothesis. The effect size coefficient obtained to determine the effect of cognitive training was 0.99 in the third post-test and 0.97 in the follow-up. Also, Kazdin's percentage improvement formula indicates a 15.4%

improvement in obsessive thoughts in the third post-test and an 18.7% improvement in the follow-up test in the subjects.

Figure 1 shows the obsessive thoughts scores for all three participants at different stage of the study. The pre-test (baseline) obsessive thoughts score was 30.33, which decreased to 25.67 in Post-Test 3 and to 24.67 in the follow-up stage. These results suggest that the cognitive training based on remote associations had an effect, leading to an improvement in obsessive thoughts in the participants.

The results of testing the second hypothesis showed that cognitive training based on remote associations led to improve the performance of patients with OCD in the CPT as an Attention Test (Table 3). The table includes the results of various components of CPT, including commission errors, omission errors, correct responses, and reaction time.

Table 1. Implementation and Training Stages

Pre-Test	Training	Post-Test 1	Training	Post-Test 2	Training	Post-Test 3	Training	Follow-Up (After One Month)
Y-BOCS CPT	Day 1-5	CPT	Day 6-10	CPT	Day 11-15	CPT	Day 11-15	Y-BOCS CPT

Table 2. Effect Size Test for Obsessive Thoughts

Stage	Mean	SD	Improvement percentage	Estimated SD	Effect size coefficient	Cohen's d
Baseline (A)	30.33	2.08				
Intervention (B)	25.67	3.21	0.154	1.15	0.99	4.04
Baseline (A)	24.67	2.31	0.187	0.58	0.97	9.81

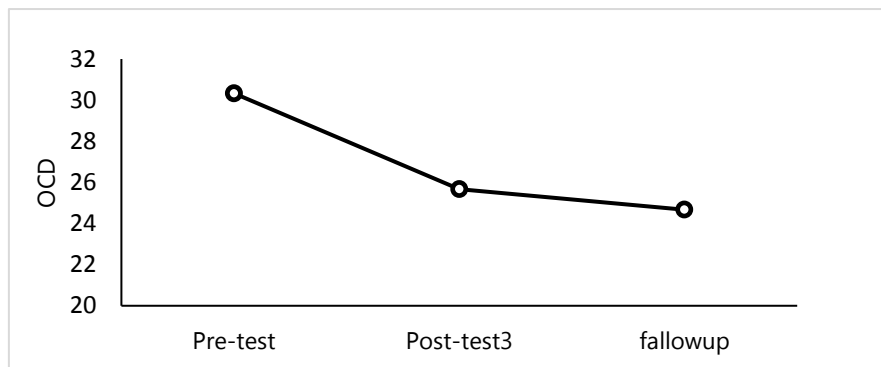


Figure 1. Obsessive thoughts score at different assessment stages.

Table 3. Effect Size Test Related to Continuous Performance Test: Commission Error, Omission Error, Correct Responses, and Reaction Time

Variable	Stage	Mean	SD	Improvement Percentage	Estimated SD	Effect size coefficient	Cohen's d
Commission Error	Pre-Test	6.67	2.30				
	Post-Test 3	2.73	1.72	70.7%	0.82	0.5	2.24
	Follow-Up	1.67	1.55	74.9%	0.83	0.5	2.52
Omission Error	Pre-Test	5.73	1.73				
	Post-Test 3	3.67	1.53	66.6%	1.55	0.75	2.89
	Follow-Up	3.00	1.00	80%	1.87	0.86	2.46
Correct Responses	Pre-Test	38.33	3.12				
	Post-Test 3	47.00	1.73	22.6%	2.08	0.91	4.16
	Follow-Up	48.67	1.53	26.9%	2.09	0.96	4.96
Reaction Time	Pre-Test	650.33	63.69				
	Post-Test 3	545.00	84.32	16.2%	52.72	0.42	2.15
	Follow-Up	511.33	81.64	21.4%	73.73	0.66	1.85

The results presented in Table 3 show a significant reduction in commission errors, with Cohen's *d* values of 2.24 in Post-Test 3 and 2.52 in follow-up, both indicating a large effect size. The percentage improvement was 70.7% in Post-Test 3 and 74.9% in the follow-up phase. Similar to commission errors, omission errors also showed significant improvements, with Cohen's *d* values of 2.89 in Post-Test 3 and 2.46 in the follow-up. The percentage improvements were 66.6% in Post-Test 3 and 80% in the follow-up. There was a notable improvement in the number of correct responses, with a significant increase from 38.33 in the Pre-Test to 47.00 in Post-Test 3 and 48.67 in the follow-up. The effect sizes were 4.16 in Post-Test 3 and 4.96 in the follow-up, indicating a very large effect. Reaction times also showed improvement, with a decrease from 650.33 ms in the Pre-Test to 545.00 ms in

Post-Test 3 and 511.33 ms in the follow-up. Cohen's *d* values were 2.15 in Post-Test 3 and 1.85 in the follow-up, showing a large effect size in both phases.

In the following, the results of all the assessments in three stages (ABA) for commission errors, omission errors, correct responses, and reaction time have been displayed in Figure 2.

This figure should illustrate the overall trend of performance changes across all stages (baseline (A), intervention (B), and follow-up (A)) for all performance indices, including omission errors, commission errors, correct responses, and reaction time. The overall improvement in commission errors, omission errors, and increased correct responses, as well as the decrease in reaction time from baseline to intervention and follow-up, is clearly evident.

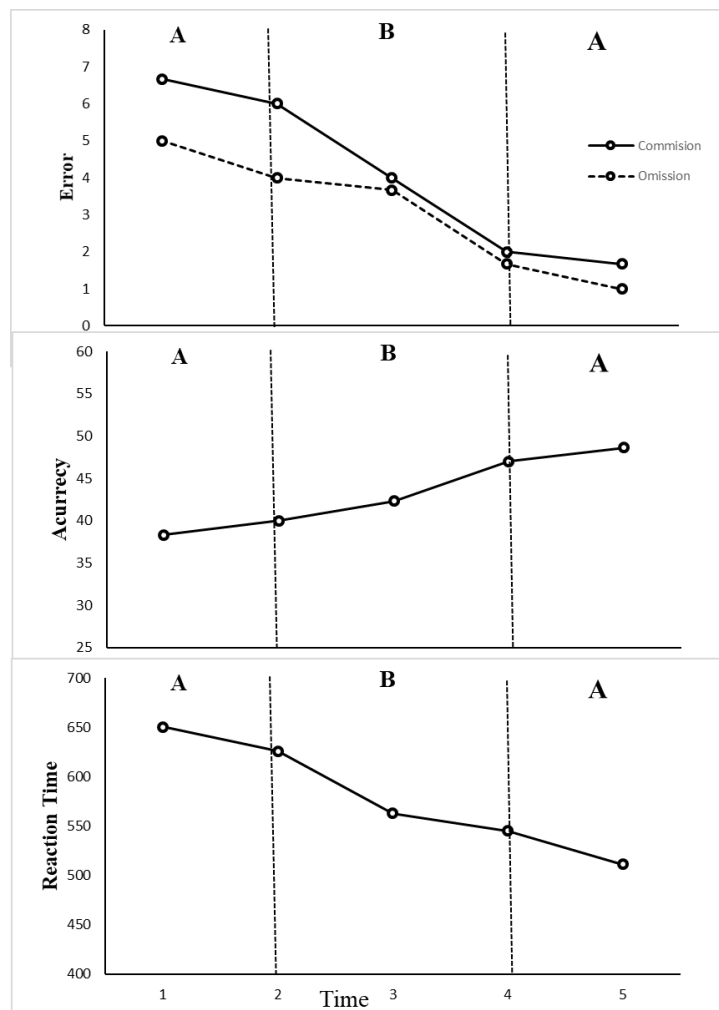


Figure 5. Participant performance across three ABA stages in sustained attention test components.

Discussion

The present study aimed to investigate the effectiveness of cognitive training based on remote associative in improving cognitive performance, particularly attention, in patients with OCD. The results of the data analysis indicated that remote associative training significantly improved both obsessive thoughts and attention performance in individuals with OCD. In line with this result, the effectiveness of cognitive rehabilitation in

improving cognitive function and attention in people with OCD has been previously reported [28]. It has also concluded that cognitive rehabilitation techniques are effective in improving selective attention in people with obsessive-compulsive disorder [18]. Accordingly, it has also been stated in an analytical review that cognitive rehabilitation interventions reduce deficits in cognitive function in patients with OCD [29].

Patients with OCD often become trapped in repetitive

thought patterns that seem to be associated with a decreased cognitive flexibility, which makes it difficult for them to shift their thoughts to other topics. Cognitive interventions that can enhance cognitive flexibility and improve performance in these patients may, therefore, be effective in reducing the symptoms of OCD. Previous studies have highlighted that CBT, especially techniques based on cognitive restructuring, can effectively reduce OCD symptoms [30]. Furthermore, improving creative thinking, which is associated with changing negative thought patterns, can help alleviate obsessive thoughts [22].

In this study, the daily training based on remote associative, using moderately emotionally charged words in Persian [31], which have shown in preliminary studies to evoke more distant and unusual associations in participants, were utilized. By "distant associations", it means that these words are capable of eliciting more diverse and remote concepts. This likely helps to open pathways to access various and different concepts from the content of obsessive thoughts.

The use of remote associative in the present study may help develop mental habits that facilitate such distant associations, aiding individuals in escaping from rumination. This approach could enhance the efficacy of non-invasive intervention and significantly reduce the need for patients' self-reflection efforts during psychotherapy. Additionally, activating remote associations prevents constant rumination and, by diverting the individual's thinking away from negative and narrow topics, aids in achieving a broader perspective [32]. Positive mood can further enhance associative memory [33], and associations play a fundamental role in learning, encoding, retrieving memory, problem-solving, creativity, and spatial navigation, thereby also providing the necessary foundation for predictions, which ultimately increases positive mood [34].

It is assumed here that associations provide a tool to shift thoughts from one representation to another. The process of rumination is associated with a limited process of associations that are surrounded by a narrow focus, which may result from excessive inhibition of the medial prefrontal cortex (MPFC). In contrast, activating remote associations involves engaging with associations that, most importantly, lead to a smooth progression of thought processes from one domain to another. As a result, this process can minimize rumination. Another benefit of activating remote associations is that these associations, by diverting thought processes from a limited and negative topic, help avoid continuous rumination (which is a hallmark of mood disorders) and facilitate access to a broader perspective. This allows thought processes to gradually move from one domain to another [32].

Conclusion

One of the advantages of using remote associations as part of treatment in patients who engage in rumination is that these patients are not forced to actively suppress their negative thoughts. The non-repetitive and free

thinking style in associations can replace the repetitive thinking seen in rumination [21]. Moreover, remote associations could be rewarding, promoting a positive mood. Therefore, the process of associative thinking becomes a pleasant experience for the individual [32]. Cognitive training based on remote associative impacted cognitive attention, particularly in reaction time. Reaction time refers to the speed at which an individual responds to a stimulus and is directly related to cognitive processes and attention [35].

Just like any other study, there were limitations. One limitation in this study was the use of remote associative training for the first time to intervene in improving the cognitive functions of patients, which led to challenges in accessing previous research on this specific intervention. Also, the small number of participants was another limitation in generalizing the results.

Based on the findings of this study, it is recommended that associative chaining exercises be incorporated into the rehabilitation programs for patients with OCD alongside other interventions. These programs can help patients strengthen their attention and cognitive performance through diverse experiences. The use of modern technologies in the development and execution of rehabilitation programs, including mobile applications and interactive digital software, can facilitate teaching distant associations. These technologies can also motivate patients by offering engaging games and exercises.

Conflict of Interest

No conflicts of interest were reported by the authors, and no financial support was received from any institution or organization.

Ethical Approval

In adherence to ethical guidelines, the general process of the study was explained to the participants, and an informed consent was obtained. Participants' privacy and confidentiality were respected, and they were given the option to voluntarily participate or withdraw from the study at any time. The research was approved under the ethical code of IR.ARAKU.REC.1401.140.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this work, the authors did not use any AI tools.

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