International Journal of Education and Cognitive Sciences
Volume 4, Number 3, 45-53, October 2023
https://iase-ijeas.com
ISSN: 3041-8828

The Effectiveness of Cognitive Rehabilitation Training on Prospective Memory and Cognitive Flexibility in Individuals with Depression

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Keywords:
Cognitive Rehabilitation Training, Prospective Memory, Cognitive Flexibility, Depression.

Individuals with depression often face significant challenges in memory and cognitive flexibility. Therefore, the aim of this study was to determine the effectiveness of cognitive rehabilitation training on prospective memory and cognitive flexibility in individuals with depression. This quasi-experimental study employed a pre-test and post-test design with both experimental and control groups. The research population consisted of individuals with depression seeking treatment at counseling centers in Ahvaz during the summer of 2023, from which 30 were conveniently sampled and randomly assigned to two equal groups. The experimental group underwent 10 one-hour sessions of cognitive rehabilitation training, while the control group received no intervention during this period. Data were collected using the Prospective Memory Subscale and the Cognitive Flexibility Inventory and analyzed using Chi-square and Multivariate Analysis of Covariance (MANCOVA) in SPSS-24. The findings indicated that there were significant differences between the experimental and control groups in both prospective memory and cognitive flexibility. In other words, cognitive rehabilitation training improved both prospective memory and cognitive flexibility in individuals with depression ($P < 0.001$). Considering the effectiveness of cognitive rehabilitation training in improving prospective memory and cognitive flexibility in individuals with depression, planning to incorporate cognitive rehabilitation training alongside other educational methods is effective in enhancing these characteristics.

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1. Introduction

Depression is one of the most common and debilitating psychological disorders, bringing with it numerous negative personal and social consequences, including high rates of mortality and disability (Kim, Jung, Han, Shin, & Jeon, 2024). This disorder encompasses a wide range of emotional and mental states, from sadness and low self-esteem to physical and cognitive impairments (Mayes, Deane, Aramburu, Yagnik, & Trivedi, 2023). Depression is a chronic and recurrent mood disorder characterized by one or more episodes of major depression lasting at least two weeks, without manic periods, affecting approximately 17% of people over their lifetimes, with about 10% of the global population needing serious treatment for it (Pourfereydoun & DashtBozorgi, 2022).

One of the challenges faced by individuals with depression is difficulty in prospective memory (Zhou, Wang, Zheng, Zhang, Ungvari, Ng, et al., 2017). Prospective memory refers to the ability to remember to perform activities in the future and requires continuous executive processing, including intention, planning, and inhibition (Hartwig, Kretschmer-Trendowicz, Helmert, Jung, & Pannasch, 2021). It involves setting and then maintaining and recalling goals and actions at the appropriate time and context (Sharma, Khan, & Kushvah, 2020). Prospective memory consists of five stages: encoding, retention, retrieval, execution, and evaluation, making planning for effective prospective memory crucial (Massa, Grisanti, Brugnolo, Doglione, Orso, Morbelli, et al., 2020). There are three types of prospective memory: time-based, event-based, and activity-based; for example, in time-based prospective memory, an intention must be recalled at a specific future time (e.g., remembering an exam at a certain hour), in event-based prospective memory a specific event must be remembered in the future (e.g., remembering to call a friend after a particular activity), and in activity-based prospective memory, one action must follow another (e.g., taking medication after dinner) (D'Iorio, Esposito, Maggi, Amboni, Vitale, & Santangelo, 2021).

Another challenge for individuals with depression is difficulty in cognitive flexibility (Eric Deuter, Wingenfeld, Otte, Bustami, Kaczmarczyk, & Kuehl, 2020), defined as the psychological process of changing cognitive schemas to adapt to changing environmental stimuli (Gura-Solomon, Yacobi, Kushnir, & Heled, 2024). Cognitive flexibility represents an individual's awareness of alternative choices and options in any situation and the willingness to adapt to these situations, developing the capacity to pursue new paths and realistic thinking styles (Park & Ammerman, 2023). It involves understanding the controllability of complex and difficult problem situations, offering diverse interpretations and solutions for those situations, and avoiding problematic situations (Cartwright, Marshall, Huemer, & Payne, 2019). Cognitive flexibility enables individuals to be efficient and effective, to depart from previous inefficient paths, to reconfigure a set of responses, and to take appropriate steps in their life journey (Huang, Siu, & Cheung, 2022). Individuals with high cognitive flexibility are curious about both the inner and outer worlds, and their lives are rich with diverse experiences, as they welcome new experiences and seek more (Cenkner, Usman, & Zalta, 2023).

One method for improving memory and cognitive flexibility is cognitive rehabilitation training (Dong, Yang, Tang, Yang, Lan, Xiao, et al., 2023), a unique approach to assist individuals with cognitive disorders to master problems, deficits, and cognitive changes following injury (Williams, Lowry, & Sims-Robinson, 2020). Cognitive rehabilitation is a method for restoring lost cognitive capabilities, using targeted stimuli and related exercises to improve cognitive functions (Lee & Lee, 2017). Based on the principles of neural plasticity, it includes targeted exercises to improve various cognitive domains and executive functions such as attention, memory, and language (Baxendale, 2020). Cognitive rehabilitation training comprises a set of programs for brain rehabilitation and empowerment, enhancing individual mental and cognitive functions and achieving personal success in academic, occupational, and social areas (Devos, Ng, Santos, Sood, Hu, Zanwar, et al., 2023). It results from the integration of cognitive neuroscience and information technology, based on the principle of brain plasticity, adjustable in task difficulty from easy to hard, creating continuous cognitive challenges (Maggio, De Luca, Molonia, Porcari, Destro, Casella, et al., 2019).

Limited research has been conducted on the effectiveness of cognitive rehabilitation training on prospective memory and cognitive flexibility. For example, Niroomand, Rezaei Dehnavi, and Etemadifar (2021) found that the Captain's Log cognitive rehabilitation program improved prospective and retrospective memory in patients with multiple sclerosis. Ashori (2020) concluded that cognitive rehabilitation improved prospective and retrospective memory in female students with hearing impairments. Ledbetter, Moore, and Mitchell (2017) found that cognitive rehabilitation training improved general cognitive abilities and all six of its components including long-term memory skills, working memory, information processing, processing speed, auditory processing, and fluid reasoning in soldiers with brain injuries. Fleming, Shum, Strong, and

Lightbody (2005) reported that prospective memory-based cognitive rehabilitation improved prospective memory in patients with traumatic brain injuries. Additionally, Baratpour and DashtBozorgi (2021) showed that cognitive rehabilitation increased quality of life, psychological flexibility, and reduced health anxiety in patients with panic disorder. Dana (2019) found that physical, cognitive, and combined rehabilitation improved working memory and cognitive flexibility in the elderly. Feizipour, Sepehrianazar, Issazadegan, and Ashayeri (2019) concluded that cognitive rehabilitation improved cognitive flexibility and selective attention in patients with multiple sclerosis. In another study, Pereira, Bonifavio, and Matos-Pires (2012) reported that cognitive rehabilitation improved memory, attention, and cognitive flexibility in patients with acquired brain injuries.

Regarding the importance and necessity of this research, it can be said that few studies have been conducted on the effectiveness of cognitive rehabilitation training on prospective memory and cognitive flexibility, and no research has been found on its effectiveness on these aspects in individuals with depression. Considering the differences that individuals with depression have with other disorders and diseases, the researchers of the current study aimed to examine and test the effectiveness of cognitive rehabilitation training on prospective memory and cognitive flexibility in individuals with depression. Additionally, the results of this study can assist therapists and health professionals in recognizing an effective educational method and planning its use in psychological interventions. As mentioned earlier, individuals with depression face significant challenges in memory and cognitive flexibility. Therefore, the aim of this study was to determine the effectiveness of cognitive rehabilitation training on prospective memory and cognitive flexibility in individuals with depression.

2. Methodology

This quasi-experimental study utilized a pre-test and post-test design with two groups: an experimental group and a control group. The research population consisted of individuals with depression who visited counseling centers in Ahvaz during the summer of 2023. To determine the sample size, the following equation was used based on Mousabeygi, Zare, and Sharifi (2020), with values of $\boldsymbol{\sigma}$ (the standard deviation of prospective memory of the experimental group in the post-test) = 7.65, d (the mean difference in the post-test prospective memory from the pre-test in the experimental group) = 10.80, test power = 0.90, and $\alpha = 0.05$. Based on this, the sample size for each group was estimated to be approximately 10.53; however, due to the high prevalence of depression and potential dropouts, the sample size was set at 15 individuals per group. Therefore, the total sample size was 30 individuals, who were conveniently sampled and randomly assigned to two equal groups.

$$n_1 = n_2 = \frac{2\sigma^2(z_{1-\frac{\alpha}{2}} + z_{1-\beta})^2}{d^2} = \frac{2(7.65)^2(10.4976)}{(10.80)^2} = \frac{1228.69}{116.64} = 10.53$$

The procedure of the study was as follows: coordination with the authorities of counseling centers in Ahvaz was established, and then 30 individuals with moderate or severe depression, as diagnosed by the therapists of the counseling centers, were selected as the sample. The importance and necessity of the research were explained to the participants, and ethical considerations were assured. They were then randomly assigned into two groups of 15, comprising the experimental and control groups. The experimental group underwent 10 one-hour sessions of cognitive rehabilitation training, and during this period, the control group received no intervention. The intervention in this study utilized the package developed by Sayadi, Eftekhar Saadi, Makvandi, and Hafezi (2019), with session-by-session content presented in Table 1.

Table 1. The Session-by-Session Content of Cognitive Rehabilitation Training

Session	Content
First	Familiarization and establishment of therapeutic alliance, general cognition of cognitive methods and exercises, and baseline assessment of cognitive functions
Second	Training on attention exercises including alertness with auditory stimuli (numbers, words, sentences, etc.), and preparing a list of life's stress-inducing events and their role in depression, memory, and cognitive flexibility

Third	Providing worksheets related to cognitive rehabilitation training, teaching attention elements skills (reading a text and finding pre-determined letters and words), and attention exercises including maintaining attention
Fourth	Training on visual and auditory attention exercises, and memory exercises including selective attention and attention processing
Fifth	Training on exercises related to attention shifting, comprehension, and cognitive expansion
Sixth	Training on exercises in maintaining attention and enhancing memory by observing ascending and descending order, and reading for comprehension while simultaneously searching for predetermined letters and words
Seventh	Training on logical, visual, and auditory memory using numbers, letters, shapes, words, and sentences
Eighth	Performing exercises to improve verbal and visual memory, verbal organization, and constructing paired associations
Ninth	Training on exercises related to planning a simple task, categorization, differentiation, and problem-solving for better decision-making in stressful and depressive conditions
Tenth	Performing exercises related to memory, cognitive attention exercises aimed at improving health, and summarizing and concluding the sessions

Data were collected using the Prospective Memory Subscale and the Cognitive Flexibility Inventory, which are described below.

The Prospective Memory Subscale, derived from the Retrospective and Prospective Memory Questionnaire by Crawford et al. (2003), consists of 16 items divided into two subscales for retrospective memory and prospective memory (each with 8 items). In this study, only the Prospective Memory Subscale was used. Items were rated on a five-point Likert scale from never (score 1) to always (score 5). The Prospective Memory Subscale score was calculated as the sum of the scores of its items, with a minimum score of 8 and a maximum score of 40, where higher scores indicate greater problems in prospective memory. The construct validity of the tool was examined using exploratory factor analysis, revealing two factors for retrospective and prospective memory with good fit. The reliability of prospective memory was calculated using Cronbach's alpha as 0.84. In Iran, Ashori (2020) reported a Cronbach's alpha reliability of 0.76 for the Prospective Memory Subscale. In this study, the reliability of prospective memory was calculated using Cronbach's alpha as 0.80.

The Cognitive Flexibility Inventory was designed by Dennis and Vander Wal (2010) with 20 items. Items were rated on a seven-point Likert scale from strongly disagree (score 1) to strongly agree (score 5). The score was calculated as the sum of the item scores, with a minimum score of 20 and a maximum score of 140, where higher scores indicate greater cognitive flexibility. They calculated divergent validity of the tool with the Beck Depression Inventory as -0.49, significant at less than 0.001, and its reliability using Cronbach's alpha as 0.90. In Iran, Ashori and Rashidi (2019) reported a Cronbach's alpha reliability of 0.89 for cognitive flexibility. In this study, the reliability of cognitive flexibility was calculated using Cronbach's alpha as 0.94.

The data obtained from the Prospective Memory Subscale and the Cognitive Flexibility Inventory were analyzed using Chi-square and Multivariate Analysis of Covariance (MANCOVA) methods in SPSS-24 software.

3. Findings

There were no dropouts in either the experimental or control group, and analyses were conducted for both 15-person groups. Chi-square test results showed no significant differences between the experimental and control groups in terms of gender and education, as the significance was greater than 0.05 (Table 2).

Table 2. Chi-Squared Results for Comparing Demographic Variables Between Groups

Variable	Level	Experimental Group	Experimental Group	Control Group	Control Group	p
		Number	Percentage	Number	Percentage	
Gender	Male	6	40%	5	33.33%	>0.05
Gender	Female	9	60%	10	66.67%	>0.05
Education	Diploma	4	26.67%	5	33.33%	>0.05
Education	Bachelor's Degree	7	46.67%	6	40%	>0.05

Education	Above Bachelor's Degree	4	26.67%	4	26.67%	>0.05

The results of the means indicated that the average prospective memory score of the experimental group decreased more than that of the control group from pre-test to post-test (a greater decrease in the prospective memory score, according to its scoring method, signifies improvement), and the average cognitive flexibility of the experimental group increased more than that of the control group from pre-test to post-test (Table 3).

Table 3. The Results of Mean and Standard Deviation of The Variables at Different Stages

Variable	Stage	Experimental Group	Experimental Group	Control Group	Control Group	Control Group
		Mean	Standard Deviation	Mean	Mean	Standard Deviation
Prospective Memory	Pre-test	24.17	3.68	23.80	23.80	4.02
Prospective Memory	Post-test	19.55	2.93	23.91	23.91	3.77
Cognitive Flexibility	Pre-test	64.22	7.38	66.73	66.82	6.82
Cognitive Flexibility	Post-test	78.40	7.06	65.36	65.12	7.12

The examination of the assumptions for Multivariate Analysis of Covariance showed that the assumptions of normality of variables at pre-test and post-test stages based on the Shapiro-Wilk test, the assumption of equality of variances of variables based on Levene's test, and the assumption of equality of covariances based on Box's M test were not rejected as the significance was greater than 0.05. Therefore, the conditions for using Multivariate Analysis of Covariance were met.

Multivariate tests results indicated that there was a significant difference between the experimental and control groups for at least one of the variables of prospective memory and cognitive flexibility in individuals with depression, as the significance was less than 0.001, with 82% of the variance in the variables being a result of cognitive rehabilitation training (Table 4).

Table 4. The Results of Multivariate Tests

Test	Value	F	p	Eta Squared
Pillai's Trace	0.78	25.79	<0.001	0.82
Wilks' Lambda	0.15	25.79	<0.001	0.82
Hotelling's Trace	2.34	25.79	<0.001	0.82
Roy's Largest Root	2.34	25.79	<0.001	0.82

The results of the Multivariate Analysis of Covariance showed that cognitive rehabilitation training significantly improved both variables of prospective memory and cognitive flexibility in individuals with depression, as the significance was less than 0.001, with 86% of the change in prospective memory and 79% of the change in cognitive flexibility being a result of cognitive rehabilitation training (Table 5).

Table 5. Tests of Between-Subjects Effects

Variable	Source	Sum of Squares	Degrees of Freedom	Mean Square	F	p	Eta Squared
Prospective Memory	Group	68.31	1	68.31	29.11	<0.001	0.86

Cognitive Flexibility	Group	172.55	1	172.55	22.69	<0.001	0.79

4. Conclusion

The results of testing the first hypothesis of the study, based on determining the effectiveness of cognitive rehabilitation training on prospective memory in individuals with depression, showed that this intervention method led to a decrease in the prospective memory score, which according to the scoring method of prospective memory, meant that cognitive rehabilitation training improved prospective memory in individuals with depression. This result is consistent with the findings of research by Niroomand et al. (2021) on the effectiveness of the Captain's Log cognitive rehabilitation program in improving prospective memory in patients with multiple sclerosis, Ashori (2020) on the effectiveness of cognitive rehabilitation in improving prospective memory in female students with hearing impairments, Ledbetter et al. (2017) on the effectiveness of cognitive rehabilitation training in improving long-term memory and working memory in soldiers with brain injuries, and Fleming et al. (2005) on the effectiveness of cognitive rehabilitation in improving prospective memory in patients with traumatic brain injury. In explaining the effectiveness of cognitive rehabilitation training in improving prospective memory based on the research by Ashori (2020), it can be said that memory is an important area that is affected by disorders, and cognitive rehabilitation can affect memory both directly and indirectly through executive functions or other cognitive functions. There are common and accepted discussions related to prospective memory, supporting the belief that prospective memory tasks are automatically related to intentions and plans, and if there are problems in an individual's prospective memory, planning will also be problematic, and part of this problem may be related to encoding, which is one of the stages of memory. Therefore, improving cognitive components based on prospective memory is interconnected. As a result, cognitive rehabilitation programs, as an educational or therapeutic method, help improve cognitive capacity and memory through memory-based strategies, instruction, repetition, and practice, and facilitate the access to information, thus improving memory. Consequently, it seems logical that cognitive rehabilitation training can improve prospective memory in individuals with depression.

The examination of the second hypothesis of the research, based on determining the effectiveness of cognitive rehabilitation training on cognitive flexibility in individuals with depression, showed that this intervention method led to an increase in the cognitive flexibility score. Given the scoring method for cognitive flexibility, cognitive rehabilitation training improved or increased cognitive flexibility in individuals with depression. This result aligns with the findings of Baratpour and DashtBozorgi (2021) on the effectiveness of cognitive rehabilitation in increasing psychological flexibility in individuals with panic disorder, Dana (2019) on the effectiveness of cognitive rehabilitation in improving cognitive flexibility in the elderly, Feizipour et al. (2019) on the effectiveness of cognitive rehabilitation in improving cognitive flexibility in patients with multiple sclerosis, and Pereira et al. (2012) on the effectiveness of cognitive rehabilitation in improving cognitive flexibility in individuals with brain injuries. In explaining the effectiveness of cognitive rehabilitation training in increasing cognitive flexibility based on the research by Baratpour and DashtBozorgi (2021), it can be said that cognitive rehabilitation training is designed and based on neuropsychological theory, on the concept that creating opportunities to stimulate a particular aspect of cognition can improve cognitive flexibility. Cognitive flexibility is defined as the ability to generate and change responses based on defined performance, and its ultimate goal is to expand and enhance cognitive and executive functions and establish new behavioral patterns for conducting skillful, cognitive, and motor activities, or to provide cognitive mechanisms for compensating for functions of the injured nervous system. Since cognitive rehabilitation training aims to compensate or adapt in the nervous system, seeking compensation through changes in the environment, habits, ways of doing things, and executive strategies, and adaptation by restoring lost cognitive capacities through exercises and targeted stimuli. Consequently, it seems logical that cognitive rehabilitation training can improve or increase cognitive flexibility in individuals with depression.

The major limitations of this study include the lack of long-term follow-up of results, the use of a non-random convenient sampling method, the limitation of the research population to individuals with depression visiting counseling centers in Ahvaz, and the lack of gender-specific results. Considering these limitations, future researchers are suggested to examine and test the sustainability of the effectiveness of cognitive rehabilitation training on various variables, use random sampling methods due to less sampling error if possible, conduct and compare current research on individuals with depression in other cities or even those with other disorders, and even investigate and compare the

effectiveness of cognitive rehabilitation training on various variables, for example, among men and women with depression. Based on the current research findings and considering the effectiveness of cognitive rehabilitation training in improving prospective memory and cognitive flexibility in individuals with depression, planning to use cognitive rehabilitation training alongside other educational methods to improve these characteristics is effective.

Acknowledgments

The authors express their gratitude and appreciation to the officials of the counseling centers in Ahvaz and the individuals with depression for their participation and cooperation.

Ethical Considerations

In this study, ethical principles such as the freedom of individuals to participate in and withdraw from the research, confidentiality, etc., were observed.

Conflict of Interest

The authors declare that there was no conflict of interest.

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