Original Article

Cognitive rehabilitation Effect on executive functions and theory of mind in children with autism spectrum disorders

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ABSTRACT

Autism is a range of Neuro-developmental disorders that disrupts the growth and development of a person's communication and social skills. This research determines the effect of cognitive rehabilitation of visual perception on executive functions and theory of mind in children with autism spectrum disorders. This study is an quasi-experimental research. Its statistical population included all students aged 6 to 12 with autism spectrum disorders in Ahvaz in the Education Department of Exceptional Children and the Khuzestan Autism Association. The sample consisted of 40 children with autism spectrum disorder. They were selected at convenience and were randomly divided into two experimental (20 people) and control (20 people) groups. The experimental group received visual perception cognitive rehabilitation intervention during 10 30-minute sessions, and the control group did not receive any intervention. We used the Behavioral Rating Inventory of Executive Function (BRIEF) and Stirenman's 38-question theory of mind test to collect information.

The results showed that cognitive rehabilitation of visual perception can significantly improve executive functions and theory of mind in autistic children. The effectiveness of visual perception cognitive rehabilitation intervention was confirmable for the executive functions of working memory and cognitive flexibility, and its effect was rejected for the inhibitory control component. As the results showed, this intervention as a practical intervention improves cognitive abilities, communication skills, and behavioral symptoms in children with autism spectrum disorders, and is usable for designing treatment protocols and increasing abilities relevant to executive function and development of the theory of mind in individuals with autism disorders.

Keywords: Autism, Cognitive rehabilitation of visual perception, Executive functions, Working memory, Cognitive flexibility, Theory of mind

Introduction

The Diagnostic and Statistical Manual of Mental Disorders in the fifth edition (DSM-IV) defines autism spectrum disorders as a group of neurodevelopmental disorders with deficits in social communication and interactions and limited and repetitive behaviors and interests [1]. Many theories have tried to explain autism spectrum disorders. The dominant and old theories about the pathological mechanisms in autism are executive dysfunction in the theory of executive function inefficiency and deficit in the theory of mind [2].

Previous studies have shown the deficit of autistic children in executive functions. Deficit in executive functions is one of the characteristics of autism spectrum disorders [3]. Increasing evidence suggests that a deficit in executive functions may be an early symptom of autism. The examination of cognitive abnormalities in the relatives of individuals with autism spectrum disorder shows the deficiency of executive functions in daily life and introduces disorder in cognitive flexibility and inhibitory control as strong clinical traits for autism spectrum disorder [4]. Nowadays, working memory, inhibitory control, and cognitive flexibility are supposedly the core sub-components of executive functions. The growth and maturity of executive functions in autism are significantly delayed in social interactions, so significant differences continue into adulthood and affect social and communication processes. As for the relationship between autism and executive functions, various research has shown that individuals with autism have defects in working memory and inhibitory control [5]* and cognitive flexibility [3]. These defects aggravate their theory of mind disorders [6].

The theory of mind, as the ability to attribute a mental state to oneself or others and use it to predict the behavior of others, explains some social and communication challenges and the inability to engage in social behaviors in autism. Each person needs a theory of mind to be aware of his behavior and the mental states of others, to respond appropriately to social expectations

and norms, and to correct his inappropriate behavior. Therefore, theory of mind is an important skill for successful social interactions [7, 8]. Thus, core weaknesses in theory-of-mind abilities explain the widespread difficulty that individuals with autism spectrum disorders experience in social situations. Some of the social and communication challenges of autism, such as the inability to engage in behaviors such as face recognition deficits, limited imitation, and the inability to engage in social behaviors are explainable by the theory-of-mind failure, namely, these behavioral symptoms are rooted in the theory-of-mind failure Researchers believe that the relevant deficiency prevents understanding, interaction, establishing, and communicating with others in a focused and useful way l.

Many individuals with autism spectrum disorder have a significant deficiency in cognitive abilities [9]. It seems that the symptoms observed in autism disorder are rooted in different patterns of perception. Meanwhile, visual perception, as the most important perceptual system in learning and imitation, has a special place in perceptual devices that play an important role in regulating many human behaviors. Children with autism often show significant challenges with visual-motor integration [10]. A hypothesis argues that any deficit in this area may be associated with the observed disorders in sensory processing and motor skill development in children with autism [11]. Chung and Son (2021) also stated that altered visual perception and unusual visual processing may cause or exacerbate social harm [12]. Neuroimaging studies in autism show that abnormal visual perception can be closely related to social impairment, which is one of the deficits in autism [13]. Neuroimaging studies also showed that executive functions and visual perception are related to overlapping neural networks in individuals with autism [14].

Sensory information is processed abnormally in autism spectrum disorder. This abnormal processing of sensory information disrupts social cognitive abilities, higher-level abilities, and limited and repetitive behaviors. These symptoms, which appear as abnormal overreaction or lack of reaction to sensory stimuli, are included in the Diagnostic and Statistical Manual of Mental Disorders [15]. The difference in sensory perception in individuals with autism spectrum disorders has been widely reported, especially in visual perception [16]. Visual-motor integration is a vital ability in child development that is associated with the performance of many executive function skills [17].

There are various interventions and programs for modulating the symptoms of autism with an emphasis on educational skills, which include intervention activities to provide an opportunity to improve the quality of life of individuals with autism disorders. One method is cognitive rehabilitation, which includes the provision of therapeutic activities for the individual's performance. Its purpose is to strengthen or re-stabilize previous behavioral patterns and new behavioral patterns to perform activities or provide cognitive mechanisms for compensating for the damaged functions of the nervous system. A visual perception rehabilitation program is an educational therapeutic process that is used to strengthen the visual perception. Therefore, various rehabilitation exercises are recommended to correct relevant vision defects. Visual perception training occurs through computer software and by using matching processes, because of which the difficulty of the assignments automatically increases throughout the treatment sessions and the client's performance is continuously challenged. This method will have a greater effect on motivating the child participants because of the rapid presentation of the stimuli. Another effective feature is the presence of feedback on the person's answers, which increases his desire to continue training and earn more points.

Various studies have mentioned the effectiveness of programs designed to support visual perception training. Pazulnejad *et al*. showed that training with computer games improves the emotional regulation of children with autism disorder. Darvishi *et al*. also showed that cognitive rehabilitation has a positive and significant effect on improving the theory of mind in autistic children. Likewise, Wan *et al*. (2017) showed that the visual perception computer training program has a positive effect on the performance of visual perception and increases cortical activities, and strengthening visual perception plays an important role in improving children's developmental tasks and academic progress [18]. Lee *et al*. (2021) show the improvement of inhibitory control in children with hyperactivity disorder because of computerized eye tracking training [19]. Cho and Ro (2020) determined the effect of visual therapy on improving symptoms of hyperactivity and visual perception in children with attention deficit-hyperactivity disorder and showed the improvement of visual performance and visual perception skills, and reducing symptoms of attention deficit hyperactivity disorder [20]. Arunachalam *et al*. (2022) showed that visual perception skills training leads to a significant improvement in the visual-spatial skills and visual-motor integration of children with autism spectrum disorders and significant changes in behavior, including improvement in attention and increase in understanding of instructions [21]. Maurya and Khan (2022) also concluded in research that the cognitive skills training program has a positive effect on the cognitive performance of children with autism spectrum disorders and causes a significant improvement in their executive performance, understanding of cognitive mental states, and central coherence [22].

It is noteworthy that the alarming prevalence of autism has been increasing in recent years so the results of the latest studies by the Centers for Disease Control and Prevention about its prevalence in 2014 showed that one out of every 59 children has autism (Cdc [centers for disease control and prevention]) [23]. Maenner *et al*. (2020) stated that the prevalence rate of autism in the world is 1 in every 50 births. Therefore, paying attention to effective interventions to improve the conditions of these children is important [24]. As for the defects in this disorder and the necessity of rehabilitation and improving the quality of life of individuals with autism, cognitive rehabilitation based on strengthening visual perception can improve executive functions and theory of mind in children with autism spectrum disorder as a working procedure to improve the main characteristics and symptoms of autism spectrum disorders, i.e. persistent deficit in communication and bilateral social interactions and repetitive and limited patterns in behavior, interests or activities. If strengthening visual perception leads to improvement of

executive functions and theory of mind in individuals with autism disorder, using cognitive rehabilitation of visual perception can increase the effectiveness of interventions as a complement to clinical interventions and lead to the development of more efficient interventions. The existing studies and the evidence of the mentioned research have tested the effectiveness of the programs for supporting the rehabilitation of visual perception, improvement of attention, inhibitory control, theory of mind, motor coordination, and visual-motor integration skills. It seems that cognitive rehabilitation of visual perception is an intervention that can lead to the improvement of executive functions and theory of mind, cognitive abilities, communication skills, and adaptive behavior in children with autism spectrum disorders. The results of this research are usable for rehabilitation centers, exceptional schools, occupational therapists, speech and language pathologists, psychologists, psychiatrists, other therapists, and cognitive science researchers. Therefore, they can add to the richness of our information in the use of intervention methods and can guide the answer to whether it is possible to improve cognitive rehabilitation of visual perception, executive functions, theory of mind, and the symptoms of autism spectrum disorders.

Materials and Methods

The present research was quasi-experimental with a pre-test-post-test design and a control group. Its statistical population included all students aged 6 to 12 with autism spectrum disorders in Ahvaz in the Education Department of Exceptional Children and the Khuzestan Autism Association. The sample consisted of 40 people. They were selected at convenience from among all the volunteers referred to the Khuzestan Autism Association, who were willing to participate in the research and who received autism index scores according to the Gilliam Autism Rating Scale (GARS) 3rd edition. The participants were randomly assigned to two experimental and control groups. The intervention was done in the experimental group and the control group did not receive any intervention.as **Table 1** shows We decided to repeat the cognitive rehabilitation intervention of visual perception for the control group after the research to comply with ethical principles. The intervention consisted of 10 sessions and each session lasted 30 minutes. The inclusion criteria for entering the research were: diagnosis of autism spectrum disorder (levels one and two) by the education of exceptional children, absence of lazy eye, vision, and hearing problems effective in the research according to the documentation in the student assessment file. Exclusion criteria: Elimination in case of absence for more than 3 sessions. The results were analyzed by MANCOVA multivariate covariance analysis using SPSS-27 software.

Behavioral Rating Inventory of Executive Function (BRIEF)

The executive function behavioral rating list has 86 items that evaluate the behaviors for executive functions in children. The present research used the original version (6-11 years old), which was completed by the parents. The items in this list are scored based on a Likert scale (from 1 for never to 3 for often). This list has three subscales: inhibitory control (14 items), cognitive flexibility (11 items), and working memory (11 items). The score of executive functions in the present research was gained from the sum of the scores of the three subscales. The minimum and maximum score in this questionnaire is 86 and 258, respectively. The validity and reliability of the Persian version of the behavioral rating list of the executive functions of the parent form have been investigated by Naimi in autistic children. Cronbach's alpha coefficients for the subscales of this questionnaire were between 0.68 and 0.86, and Cronbach's alpha calculated for the total score of this list was 0.93. This shows the high internal consistency of this list [25]. The present research obtained the reliability of the entire questionnaire using Cronbach's alpha methods (0.93).

Theory of Mind Test: Steernman (1999) developed the theory of mind test. The main form of this test is to measure the theory of mind in normal children and children with pervasive developmental disorders for the ages of 5 to 12 years. Qomrani *et al*. (2015) reduced the number of test questions from 72 to 38 and used Persian names instead of foreign names. This test includes pictures and stories. The examiner asks questions after presenting them to the participants. It is made up of 9 separate examples. This test has three subscales. 1. The first level of theory of mind 2. The second level of theory of mind 3. The third level of theory of mind. Each example has some questions; three levels of theory of mind (first, second, and third) are specified in front of each question. The subject's score in the whole test will be between 0 and 38. A higher score on this test shows that the child has achieved higher levels of theory of mind. Qomrani *et al*. (2015) measured its validity and reliability on several students with special educational needs and normal students in Shiraz. Content validity, correlation of three subtests with total score, and simultaneous validity were used to investigate the validity of this test. The reliability of the test was checked by the test-retest method, Cronbach's alpha, and the reliability of the agreement between the raters, and the reliability coefficient of the scorers was 0.98. The findings showed that Steernman's 38-question theory of mind test is a valid tool for use in Iran. The present research obtained the reliability of this tool using Cronbach's alpha (0.85).

Table 1. Summary of visual perception rehabilitation sessions using visual perception rehabilitation software

Sessions	Time	Session content
First	30	Communicating with the student and the eye-tracking task
Second	30	Visual tracking task
Third	30	Stimulus detection task
Fourth	30	Stimulus detection task
Fifth	30	Picture matching task
Sixth	30	Picture matching task

Seventh	30	Difference detection task
Eighth	30	Difference detection task
Ninth	30	Naming tasks
Tenth	30	Naming tasks

Results and Discussion

Chi-square and Fisher's exact test showed that the two control and experimental groups are similar and homogeneous in the underlying characteristics of the child's gender, parent's gender, parent's age, and education ($p < 0.05$). As the findings reveal, the significance level of the homogeneity test was greater than 0.05. It showed that there is no difference in demographic characteristics between the experimental and control groups.

the average of executive functions and theory of mind in the experimental group had an increasing trend. There is no significant difference between the average variables in the pre-test and post-test in the control group.

The results of the Shapiro-Wilk test showed that the research variables had a normal distribution. The value of skewness and kurtosis of all variables was in the range of ±2, which indicates the normality of the data. The results of Levine's test showed that the homogeneity of variances was maintained for inhibitory control, working memory, and theory of mind, and it was not maintained for the two variables of flexibility and executive functions. Since both groups had the same number of participants, a violation of this assumption is negligible.

Table 2. Testing the interaction effect of the intervention and pre-test variables to determine the homogeneity of the regression slopes

Variable	Interaction type	F value	p-value
Inhibitory control	Pre-test*group	۷۵.۱	۱۹۵.۰
Flexibility	Pre-test*group	۴۹.۳	۰۷۰.۰
Working memory	Pre-test*group	۰۴.۴	۰۵۲.۰
Executive functions	Pre-test*group	۴۳.۳	۰۷۲.۰
Theory of mind	Pre-test*group	۱۱۳.۰	۷۳۹.۰

As the results of **Table 2** show, the significance level in all cases except for the interaction of working memory, pre-test, and group is greater than the value of 0.05 ($p < 0.05$). Independent groups test was performed on the difference between the pre-test and post-test of working memory beside the MANKOVA T-test. The results showed that a significant difference was observed in the mean difference of the working memory variable ($p<0.05$). The mean difference of the two working memory variables in the experimental group was significantly higher than in the control group. It reveals that the interaction effect between the group and pre-test variables is rejected. Consequently, the regression slopes are homogeneous in all cases, and this assumption is confirmable.

Table 3. Results of the homogeneity test of variance-covariance matrices (Mbox test)

Statistic	Components of executive functions	Main variables
Box's M	۴۰.۱۴	۴۰.۱۴
F statistic	۱۹.۲	۱۹.۲
Degrees of freedom	۶	۶
Significance level	۰۴۱.۰	۰۴۱.۰

As **Table 3** shows, the level of significance in the Mbox test and F value was significant and less than 0.05 ($p < 0.05$). Considering the significance level which is less than 0.05, all multivariate tests, especially the Pillai's trace, were reported in the inferential part.

Table 4. Results of multivariate covariance analysis on mean post-test scores of theory of mind variables and executive functions in groups

Change source	Test	Value	F statistic	p-value	Effect size	Test power
Group	Pillai's trace	۴۶۷.۰	۳۲.۱۵	۰۰۱.< ۰	۴۶۷.۰	۹۹۹.۰
	Wilks' Lambda	۵۳۳.۰	۳۲.۱۵	۰۰۱.< ۰	۴۶۷.۰	۹۹۹.۰
	Hotelling's trace	۸۷۶.۰	۳۲.۱۵	۰۰۱.< ۰	۴۶۷.۰	۹۹۹.۰
	Roy's Largest root	۸۷۶.۰	۳۲.۱۵	۰۰۱.< ۰	۴۶۷.۰	۹۹۹.۰

Table 4 shows the effectiveness of multivariate analysis. We can conclude that the cognitive rehabilitation intervention of visual perception had an effect on at least one of the dependent variables of executive functions and theory of mind ($p < 0.05$). The Pillai's trace was equal to 0.467 and the effect size was 0.467.

Table 5. Results of the single-variable covariance analysis test in the MANCOVA on the post-test of the theory of mind and executive functions with the control of the pre-tests

Change source	Dependent variable	Total squares	Degrees of freedom	Mean squares	F statistic	p-value	Effect size
Group	Theory of mind	۹۸.۸۰	1	۹۸.۸۰	۱۳.۱۶	۰۰۱.< ۰	۳۰۹.۰
	Executive functions	۳۷.۱۱۷۸	1	۳۷.۱۱۷۸	۰۵.۱۲	۰۰۱.۰	۲۵۱.۰

Table 5 shows Examining the effect sizes showed that the effect of cognitive rehabilitation of visual perception on the theory of mind (0.309) was more than the effect of cognitive rehabilitation of visual perception on executive functions (0.251).

Table 6. Multivariate covariance analysis test on the post-test of executive function components in groups

Change source	Test	Value	F statistic	p-value	Effect size
Group	Pillai's trace	۲۲۵.۰	۱۹.۳	۰۳۶.۰	0.225
	Wilks' Lambda	۷۷۵.۰	۱۹.۳	۰۳۶.۰	0.225
	Hotelling's trace	۲۹۰.۰	۱۹.۳	۰۳۶.۰	0.225
	Roy's Largest root	۲۹۰.۰	۱۹.۳	۰۳۶.۰	0.225

Table 6 shows the effectiveness of multivariate analysis. We can conclude that the intervention of cognitive rehabilitation of visual perception had an effect on at least one of the components of executive functions ($p < 0.05$). The test value of Pillai's trace was equal to 0.225 and the effect size was 0.225.

Table 7. Results of the single-variable covariance analysis test in the MANCOVA on the average scores of the post-test components of the executive functions in the groups

Change source	Dependent variable	Total squares	Degrees of freedom	Mean squares	F statistic	p-value	Effect size
Group	Inhibitory control	۰۱.۷۶	1	۰۱.۷۶	۳۱.۳	۰۷۷.۰	۰۸۶.۰
	Flexibility	۸۳.۱۱۸	1	۸۳.۱۱۸	۰۸.۱۰	۰۰۳.۰	۲۲۴.۰
	Working memory	۲۷.۶۱	1	۲۷.۶۱	۳۴.۶	۰۱۷.۰	۱۵۳.۰

As **Table 7** shows, the effect of visual perception cognitive rehabilitation intervention was confirmed on the two components of flexibility and working memory ($p < 0.05$). So cognitive rehabilitation intervention of visual perception improved flexibility and working memory.

The present research investigated the effect of cognitive rehabilitation of visual perception on executive functions and theory of mind in children with autism spectrum disorders. The results of multivariate covariance analysis showed that cognitive rehabilitation of visual perception improves executive functions in children with autism spectrum disorders. These results are in line with the findings of Nejati (2021) and Maurya and Kahn (2022) [6, 22]. Neuroimaging studies showed that executive functions are associated with visual perception, through overlapping neural networks, in individuals with autism. The visual input from the dorsal and ventral visual pathways converges to the frontal part of the brain, in a way that leads to increased adaptation by strengthening the visual processing systems (Bhamik *et al*. 2018). These connections underlie executive function abilities (working memory, inhibitory control, and cognitive flexibility). It seems that the different levels of visual perception cognitive rehabilitation exercises during the visual perception rehabilitation sessions provide the development of visual processing systems and thus pave the way to the development of executive functions and improve executive functions.

The results also showed that cognitive rehabilitation improves visual perception of the theory of mind in children with autism spectrum disorders. This finding is in line with the research results of Nejati (2021), Tian *et al*. (2021), and Maurya and Kahn (2022) [6, 22, 26]. So exercises were carried out under the title of visualizing the surrounding environment and changing and mentally reconstructing them for the cognitive rehabilitation of visual perception. These exercises strengthen visual memory and increase the skill of mental imagination in a person by repeatedly doing this type of exercise. Neuroimaging in autism shows that abnormal visual perception can be closely associated with social impairment and theory of mind, which is one of the deficits in autism [13]. Since visual-spatial abilities are important for the development of various aspects of the theory of mind (Nejati, 2021), the visual perception rehabilitation exercises that were presented to strengthen the ability of visual closure for the experimental group, increased the awareness of the signs in the surrounding environment and make it possible to recognize objects without all the details [6]. It combines the general information of the body and other emotions to create efficient and coordinated behaviors in space and time and apply emotions under a variety of external and internal conditions [20]. Therefore, it can be effective in the overall perception of the stimulus without considering the details. It is also defined as information processing, analysis, and description of visual stimuli of objects and events, which can strengthen the theory of mind through understanding behavioral signs, interaction, and communication with others in a focused manner. Cognitive rehabilitation of visual perception by strengthening information processing makes it possible to discover the structure and pattern of information processing. As mentioned in the previous section, this set of exercises, especially visualization exercises, increases the understanding of the material [27]. Thus, we can expect that these exercises could lead to an increase in the theory of mind.

The results of MANCOVA analysis showed that cognitive rehabilitation of visual perception improves working memory in children with autism spectrum disorders. Arunachalam *et al*. (2022), Fang *et al*. (2017), Zhang *et al*. (2020), and Nejati (2021) also showed that cognitive rehabilitation of visual perception has a positive and significant effect on working memory [6, 17, 21, 28]. Studies on memory in children with autism show that normal individuals use semantic and syntactic signs in remembering things, but children with autism are not superior in memorizing and recalling meaningful items compared to meaningless items. Working memory is guided by the prefrontal part and requires cognitive processes. Researchers also point to the importance of the parietal and frontal lobes in working memory performance, so that the supramarginal gyrus of the parietal and frontal regions plays a role in maintaining and storing information in working memory tasks Brain imaging methods show also the connection between the frontal-parietal lobe and the processing and storage of information in working memory .Since the ability to use previous experiences for the current situation and to use problem-solving strategies for the future is associated with working memory, and the functioning of working memory in autism depends on the nature of the stimuli the individuals must remember (Nejati 2021), working memory can be improved with visual perception training by activating the frontal-occipital regions [6]. Memory performance depends on the type of learning. This research performed repeatedly exercises that strengthen visual memory through discovering the stimulus and adapting the images, which means visual recall and changing and mentally reconstructing them. The skill of mental imagination increases in a person by performing these exercises and enables him to keep an image in his mind for a short period. Visual training to focus on an object can cause the growth of dendrites in nerve cells, which allows the cell to connect with

other brain cells. The visual perception training program is effective in improving the performance of visual perception and increasing related cortical activities; this process helps to form strong neural pathways and connections. It seems that shape and context exercises, shape stability, spatial orientation, and relationships between objects improve working memory by involving areas of working memory in a program based on cognitive rehabilitation of visual perception [4]. Thus, visual perception training improves working memory in children with autism.

The MANCOVA analysis showed no significant difference between the inhibitory control scores in the experimental group compared to the control group. The results of this part of the research were in line with the research of Torell *et al*. (2009) and were inconsistent with that of Lee *et al*. (2021) [19]. As for this hypothesis, the ability to inhibit an irrelevant response is supposedly one of the most important executive functions. Children who have problems with inhibition cannot ignore the information they do not need and stop a thought or action suddenly. Since stimulus selection, response selection, and response execution tasks each require inhibition at different stages of processing [29], disturbance in the ability of the circuits of the frontal part of the brain in inhibitory control is supposedly a kind of stagnation. It seems that the results of the present study are in conflict with accepting this hypothesis and that inhibitory control deficiency can endanger working memory ability and lead to the destruction of children's working memory [30]. This hypothesis states that the skills of working memory can only be developed in this way, while the results of this research show that the development of working memory skills is also possible without improvement in inhibitory control. However, the amount and direction of brain activity changes associated with cognitive rehabilitation may depend on the demands of a specific task and its difficulty level . High-level inhibitory functions are controlled by a network of cortical connections, and the frontal lobe, which is responsible for inhibiting controlled motor responses, requires high precision and simultaneous processing for proper functioning [31]. Weak central coordination and weakness in underlying information processing, slow processing speed, and difficulty in attention to relevant and irrelevant information lead to weakness in inhibitory control. Possibly the cognitive rehabilitation program of visual perception does not perceive the stimulus at different levels of information processing, and the amount of repetition and practice is not enough for the deeper processing level and the appropriate response to the stimulus, and the overload or complexity training is not enough to involve the relevant cognitive function. It seems that providing exercises based on the rehabilitation of visual perception without allocation for the function of inhibitory control has prevented the improvement of this function. Skills such as language and intelligence may also be of effect on the perseveration of children with autism . Although executive functions were improved in this study, the difference in inhibitory control did not reach a significance level. Perhaps a reason for this contradiction was the insufficient duration of the intervention exercise that caused the lack of effect of these exercises on the inhibitory control component.

Finally, the results showed that the visual perception cognitive rehabilitation intervention could improve the flexibility component in the experimental group. The results of Nobile *et al*. (2018) are in line with the results of the current research [32]. We should note that cognitive flexibility is one of the major components of executive functions and is associated with executive function and the ability to choose the appropriate practical response among the available options. Cognitive flexibility requires the functional integration of different components of the prefrontal cortex. Since the visual perception computer training program has a positive effect on the performance of visual perception and increasing cortical activities [18], the effect of cognitive rehabilitation exercises on this component will make a change in brain function. One of the reasons for this relationship is probably the anatomical proximity of neural circuits of cognitive flexibility and visual perception. Visual perception provides a foundation in children's cognitive activities to adapt to the environment and control behavior . Therefore, the cognitive rehabilitation exercises of visual perception during each session by affecting the interpretation of the visual stimulus and the ability to organize information increase, while doing another task, the ability of the person to retain information in the brain. This improvement causes in parallel some quite noticeable changes in the organization of the changing stimuli in the environment, and the child's ability to be cognitively flexible. So the effect of visual perception cognitive rehabilitation exercises on flexibility is justifiable and confirmable.

The current research, like other research, has faced some limitations, such as lack of access to a sufficient sample, individuals' avoidance of participating in the research because of the spread of Corona, and fewer female participants than male ones, which prevents the comparison of two groups in research variables; the scope of autism spectrum disorders made it difficult to implement visual perception cognitive rehabilitation exercises on all spectrums of autism patients.

Therefore, the researchers should use a larger sample as much as possible in the next research and add a follow-up stage to the research. Similar research also should be done on children with other disorders (learning disorders, attention deficit, etc.). Because the effect of cognitive rehabilitation of visual perception on inhibitory control was not confirmed in this study, other assessment tools of inhibitory control should be used in a similar study for further investigation. Finally, since cognitive rehabilitation of visual perception leads in this study to improve executive functions and theory of mind in children with autism disorder, some interventions and educational programs with an emphasis on cognitive rehabilitation of visual perception are necessary with the aim of developing executive functions and modulating autism symptoms, including intervention activities to provide opportunities for quality improvement of the level of life of individuals with autism disorders. The specialists of exceptional children's education centers, psychologists, children's education trainers, and those involved in educational

affairs, especially teachers, trainers, and parents should use the cognitive rehabilitation method of visual perception along with other interventions.

Conclusion

As studies have shown, a disorder in visual information processing speed in individuals with autism is associated with problems in their social and communication skills and communication problems of social skills in autism spectrum disorder can be associated with different patterns.

Studies have also shown that some skills can be improved in individuals with autism by using cognitive rehabilitation methods. The visual perception training, which is based on the principles of cognitive rehabilitation, has been fruitful in improving the participants' skills of executive functions and theory of mind.

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