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The effectiveness of computer games on communication skills and emotion regulation of children with autism spectrum disorder

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Abstract

Introduction: Different intervention programs are offered and implemented for autistic children. Due to using the artificial and machine instrumentals, computer games may be effective in teaching children with autism. This research aimed to determine the effectiveness of computer games on communication skills and emotion regulation of children with autism spectrum disorders.

Materials and Methods: The statistical population of this study included all children with autism disorder aged 7 to 9 years at the rehabilitation center in Tehran in 2019. For this purpose, 20 children were selected by the convenient sampling method and randomly assigned into two equal groups. The research instruments included the Social Communication Questionnaire (Rutter, Bailey, and Lord, 2003) and the Emotion Regulation Checklist (Shields and Cicchetti, 1998). The experimental members were trained with computer games in twelve 45-minute sessions three times a week. The data were analyzed by using covariance analysis and SPSS software.

Results: The results showed that computer games significantly affected the emotion regulation of children with autism disorder ($P < 0.01$). However, this effect on the communication skills was not significant ($P > 0.05$).

Conclusion: It can be concluded that training with computer games improves the emotion regulation of children with autism disorder. Therefore, families, educational institutions, and psychological and counseling services centers can benefit from this method to improve this disorder.

Keywords: Communication skills, Computer games, Emotion regulation

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Introduction

The number of children with autism is increasing every year (1). Recent statistics show the prevalence of this disorder from 0.5 to 1% in the population of each community (2). Autism disorder occurs in the first years of life, but the definitive clinical diagnosis is before three (3).

Autism disorder is identified based on two criteria of damage in communication and social interaction; and restricted and repetitive patterns of interests and activities (4). Autistic children have numerous behavioral problems, including stereotypical behaviors, head-banging, self-stimulation, aggression, and echolalia (5). In addition, individuals with this disorder have a problem with processing and emotional regulation of themselves and others (6). The problem of emotion regulation in individuals with autism is the cause of many behavioral, social, and feeling problems (7). This emotional defect is due to a defect in own cognitive and emotions and, as a result, a defect in emotional regulation (8). This defect limits individuals' ability to predict the emotions of others and themselves cognitively, and this causes a defect in their social relationships with others (9). Deficiency in establishing emotional relationships is one of the characteristics of such individuals (10). Fridenson-Hayo et al. showed that children with autism have a problem with diagnosing real and complex effects (11). Social communication problems in these individuals cause a severe decline in performance, weakness in pioneer for establishing social interactions, and rejection of others' requests to establish social relationships (12). Poushneh, Siam, and Abedi (13) believe that reciprocal imitation (one of the communication skills) increases the ability to imitate autistic children during game interactions. The research results by Yan and Charragain (14) showed that training in the diagnosis of emotional states by focusing on the component of facial expressions in children with autism improved emotional states and some generalizations for diagnosis. Trevisan and Birmingham concluded that the ability to recognize facial expressions has a positive effect on adaptive functions (15).

Various intervention programs are offered and implemented for autistic children. One of the new approaches that help to reinforce and rehabilitate cognitive components are computer games.

Mayer believes that computer games influence teaching and learning (16). Computer games in the field of cognitive sciences are exercises for the brain that enable the activation of damaged parts of the brain or reinforce its healthy parts (17). Blumberg et al. reported using digital games as a basis for cognitive development in childhood. However, unfortunately, the physical structure of the computer causes individual use (18). Individuals with a personal computer spend more time alone and less time with family and friends (19). Akrami and Sedaghat showed that computer games positively and negatively influence children with an autism spectrum disorder. So, these games will cause increase children's social skills, communication skills, eye contact, and eye-hand coordination and fill their free time. However, long-term and uncontrolled use of such games makes them addiction in children and increases isolation, anxiety, and physical pain (20). The research results by Ploog et al. showed that computer programs have high effectiveness in increasing the social and communication skills of learners with autism (21). The research results by Irani showed that smart android games significantly increased emotional interactions in children with autism (22). Lobel believes that designing computer games is very helpful for improving cognitive emotion regulation (23). Atashak, Baradaran, and Ahmadvand showed that educational computer games do not increase the variables of cooperation and self-assertiveness but are effective in self-control (24). Mairena et al. believe that the video game "Pico's Adventure" is the appropriate instrument to reinforce the social behaviors of children with autism. This game was effective in reducing stereotypical behaviors and increasing movements (25). Villani et al. considered video games as communication and practical instrumentals for understanding and influencing emotional regulation (26). Rajabiyan Dehzireh et al. believes that computer games effectively improve the students' cognitive emotion regulation (27). Mohammadi Nasab believes that computer games cause positive excitement (28). Nouri Rad and Bonyadi showed a significant relationship between some components of emotional intelligence, such as emotional self-consciousness, with the extent of playing a computer game (29). Ramezani Farani,

Gharraaei, and Salek Ebrahimi showed that using face processing and emotion recognition computer programs in students with autism spectrum disorder improves their social skills (30). According to the conflicting results of research, and considering that yet research has not been on the effect of computer games on the communication skills and emotion regulation in children with autism, a study is needed that studies the effect of these games on research variables. In this way, strategies can be considered to increase communication skills and emotion regulation in children with autism. Furthermore, this study helps to understand that playing computer games will change the level of communication skills and emotion regulation in children with autism. Therefore, this study aimed to investigate the effect of computer games on the communication skills and emotion regulation of children with an autism spectrum disorder.

Materials and Methods

The statistical population included all high-functioning autistic children aged 7-9 years at the Rehabilitation Centers in Tehran in 2019. To determine the sample size was used from the formula sample size to compare the two means (31). For this purpose, 20 children were selected by the convenient sampling method and randomly were assigned into two equal groups. Inclusion criteria included the child with a high-functioning autism disorder to be diagnosed by a psychiatrist of the center, aged of 7-9 years, parents' written consent, and minimum level of parental education be in the middle school. Exclusion criteria included absence of more than three sessions in the training games course, the

child to be not desired to the presence in games sessions, having a sensory disorder such as blindness and hearing loss or physical-motor disorders such as cerebral palsy, changes in the curative dose of medication of child, and the child be present in similar intervention as simultaneously.

First, necessary licenses were taken from the Islamic Azad University, Science and Research Branch to introduce the special autism centers (one university center and two private centers) in Tehran. After announcing the authorities' readiness, held a justification meeting for the children's parents, and written consent was obtained from the parents. Then, the parents answered the questionnaires, and their scores were recorded for the pretest. Then, for the experimental group, the independent variable, computer games intervention, was done in twelve 45-minute sessions three times a week. The control group was assigned into the waiting list. After completing these training game sessions according to the pretest method, the emotion regulation and communication skills scores were measured again for both control and experimental groups. In order to comply with the ethical considerations of the subjects, their questionnaires were coded, ethics fundamentals such as information remained confidential, and secrecy was fully observed. This research with code IRCT20210102641084N1 in the site clinical trial research has been recorded.

Introduction of computer games: In this study, the computer game was trained by Emo Game software. The content validity of this program was confirmed by several experts in psychology and education of exceptional children.



Figure 1. Emo Game environment

Emo Game computer games use a multimedia approach. The style of the game is in the form of simulation. These games are a game-centered environment and have two versions, Windows and Android. For running the game in a Windows environment. The computer system must be equipped with a camera. Computer practicing protocols for communication skills and emotion regulation include two applications called Emo Galaxy1 and Emo Galaxy2. In the Emo Galaxy1 game environment, the child is asked to position his/her face inside the shape on the screen and click on one of the planets. Clicking on the planet reveals an activity to be performed by the child. After performing the activity requested by the child, the robot standing on the planet in the middle of the screen imitates and repeats that activity. If the child completes the activity correctly, the background screen turns green, and in case of error, its color will turn red. In the game Emo Galaxy2, the child is asked to position his/her face inside the shape on the screen. Then, we ask the child to imitate the feeling that he was asked. Finally, the child must take a picture of him/herself by clicking on the button in the middle of the image. If the photo is harmonious with the requested feeling, the background screen turns green, and in case of error, its color will turn red.

Research instruments

A) *Social Communication Questionnaire*: The questionnaire was made by Rutter, Bailey, and Lord and was standardized by Sasanfar and Ghadami (2005) in Iran. This questionnaire applies to children four years and older with a mental age of at least two years. This instrumental has 40 questions that will be answered (yes or no) in less than 10 minutes (32,33). The content validity of the test was reported as 0.70, and the reliability of the test by Cronbach's alpha coefficient was between 0.84-0.93 (32).

Sasanfar et al. Cronbach's alpha coefficient for the total test was 0.90. The test correlation coefficient was 0.78 (33).

B) *Emotion Regulation Checklist (ERC)*: This instrumental was made by Shields and Cicchetti for children aged 4-16 years. The checklist consists of 24 items and has two subscales of Adaptation Emotion Regulation and Emotional Lability/Negativity. Questions will be answered in less than 10 minutes. The items were graded on a four-point Likert scale (1: never to 4: always). Higher scores indicate extreme and irrelevant emotional reactions (34). In one study, Cronbach's alpha was 0.90 for Emotional Lability/Negativity and 0.79 for Adaptation Emotion Regulation (35). In the study by Mahmoudi et al., the content validity was confirmed by three experts in psychology, and the reliability of this instrumental was obtained medium alpha (36).

Data analyzed through the descriptive statistics, analysis covariance (ANCOVA) and multivariable analyze of covariance (MANCOVA), and SPSS software (version 23).

Results

The mean age of children (7 girls and 13 boys) was 8.25 ± 0.78 years. The mean age of mothers was 37.55 ± 3.74 years. The distribution of mothers' education showed that 2 (10%) of them had middle school; 7 (35%) of them had a diploma and bachelor's degrees; 4 (20%) of them had master's degrees.

Also, the distribution of fathers' education indicated that 5 (25%) of them had the middle school, 7 (35%) of their fathers had a diploma, and 8 (40%) of them had a bachelor's degree. Initially, descriptive indices were calculated for each variable. The results are presented in Table 1.

Table 1. The mean and standard deviation of the variables in pretest and post-test

Variable	Group	Pre-test	Post-test
		Mean \pm SD	Mean \pm SD
Communication skills	Experimental	25.60 \pm 2.75	26.80 \pm 2.65
	Control	25.30 \pm 2.26	25.00 \pm 1.82
Emotion regulation	Experimental	48.90 \pm 2.42	55.30 \pm 1.49
	Control	53.90 \pm 1.85	51.50 \pm 2.27

According to Table 1, the mean of research variables in the experimental group has increased in the post-test stage. The tests analysis covariance (ANCOVA) and analysis covariance (MANCOVA) were used. In the following, defaults of multivariate analysis of covariance were performed. First, the Kolmogorov-Smirnov test was used to investigate the normality of research variables. The Kolmogorov-Smirnov test showed that the values obtained were higher than 0.05, and the distribution of scores was normal.

The results of the Levene test also indicate that the assumption of homogeneity of variances of error of research variables was observed. Finally, the results of Box's test showed that the covariances are equal in the two groups, and the test default was established concerning the significance level. Therefore, the use of the analysis of covariance was unimpeded. Then, quadruple tests of multivariate analysis of covariance were used for communication skills and emotion regulation. The results are shown in Table 2.

Table 2. The results of the analysis of covariance in posttest

Source	Effect	Value	F	Hypothesis df	Error df	P
Group	Pillai's trace	0.63	13.02	2	15	0.001
	Wilks' lambda	0.36	13.02	2	15	0.001
	Hotelling's trace	1.73	13.02	2	15	0.001
	Roy's largest root	1.73	13.02	2	15	0.001

According to Table 2 and considering the Hotelling's T statistic with a value (1.73) and a significant level ($P < 0.001$), the results showed that the post-test had a significant difference between the experimental and control groups in

the communication skills and emotion regulation. Analysis covariance (ANCOVA) was used to investigate communication skills and emotion regulation. The results are shown in Table 3.

Table 3. The results of the analysis of covariance (ANCOVA) effect of computer games on communication skills

Source	Sum of squares	Degree of freedom	Mean of squares	F	P	Effect size
Pre-test	26.36	1	26.36	6.33	0.023	-
Group	7.76	1	7.76	1.86	0.191	0.104
Error	66.61	16	4.16			
Total	13526.000	20				

Based on the results in Table 3, the first line shows the influence of the covariate variable. This F value is significant (6.33), and a significant level is less than 0.05.

Therefore, the defaults of correlation of covariate and independent variables have been observed. The results of the analysis covariance (ANCOVA) showed that communication skills had not shown

a significant difference between the experimental and control groups ($F = 1.86$ and $P > 0.05$). Due to the values mean of this variable for the experimental group in the pretest (25.60) and post-test (26.80), it can be seen that training has caused an increase in the mean scores of subjects in the post-test; but this difference is not significant. The effective rate of education was 0.104.

Table 4. The results of the analysis of covariance (ANCOVA) effect of computer games on emotion regulation

Source	Sum of squares	Degree of freedom	Mean of squares	F	P	Effect size
Pre-test	19.04	1	19.04	6.40	0.022	-
Group	75.93	1	75.93	25.55	0.001	0.61
Error	47.54	16	2.97			
Total	57170.000	20				

Based on the results in Table 4, the first line shows the influence of the covariate variable. This F value is significant (6.40), and a significant level is less than 0.05. Therefore, the defaults of correlation of covariate and independent variables have been observed. The univariate analysis of covariance results shows a significant difference between the experimental and control groups in emotion regulation ($F= 25.55$ and $P< 0.001$).

Due to the values mean of this variable for the experimental group in the pretest (48.90) and post-test (55.30), it can be seen that training has caused an increase in the mean scores of subjects in the post-test. The effective rate of education was 0.61. Finally, Figures 2 and 3 show the process of changing the means of variables during two stages (pre-test and post-test) and in two groups (experimental and control).

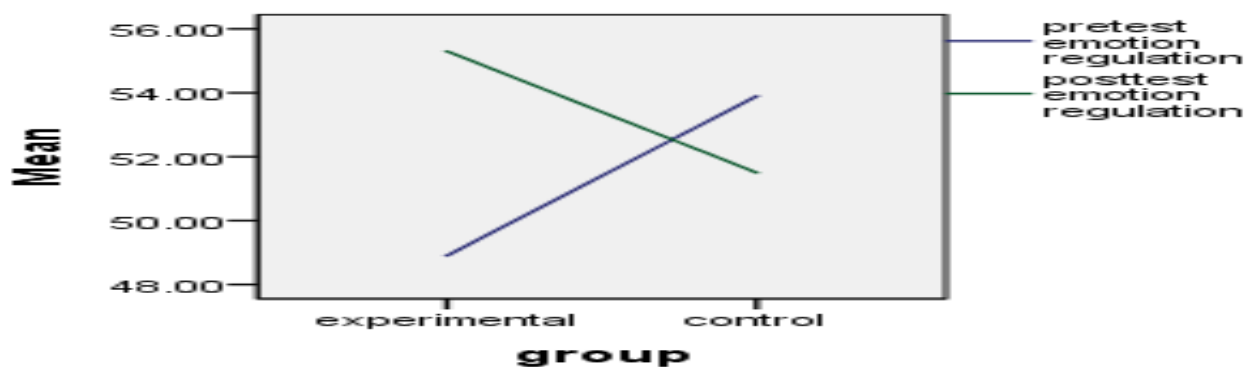


Figure 2. Comparison of communication skills in the pre-test and the post-test

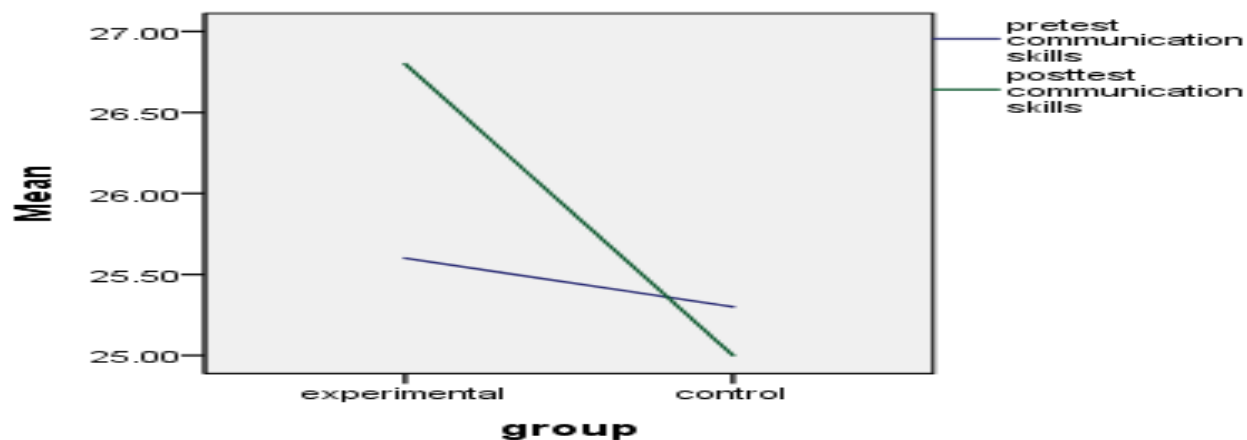


Figure 3. Comparison of emotion regulation in the pre-test and the post-test

Discussion

This study aimed to investigate the effectiveness of computer games on communication skills and emotion regulation of children with autism disorder. The analysis of covariance showed that computer games had a significant effect on emotion regulation in children with autism, although the enforcement of training increased

the mean scores of children's communication skills, this effect was not significant. The result is consistent with several studies (14,15,20-30).

In the study conducted by Yan et al. on 30 autistic children aged 9-10 years, the results showed that training in the recognition of emotion states by focusing on components of facial expressions improved the ability to

recognize facial expressions of emotion and the present study supported their findings (14). Irani believes that smart android games increase emotional interactions in children with autism, consistent with the present study (22). Lobel evaluated 194 children who aged 7-12 years from the Netherlands using the Strengths and Difficulties Questionnaire (SDQ) and showed that computer games are appropriate for improving cognitive emotion regulation, which is a confirmation of this research (23). Also, Mairena et al. showed that the videogame affected positively on social initiation behaviors of 15 children with autism and confirmed the results of this study (25). We can say that autistic children have a problem with their emotional perception. Emotional deficits in these people are due to defects in cognition and naming emotions of themselves and, as a result, deficits in emotional regulation. Computer games positively affect cognitive skills, and the changes in emotions can be taught with computer games. As explained, playing Emo Game computer games positively affected children's cognitive skills and increased their cognitive emotion regulation strategies. Training to identify the facial expression of emotions had improved the emotions of the children in the present study.

After playing these games, these children paid more attention to people's eyes and gave more appropriate answers to the visual cues from faces. They could recognize the basic facial emotions such as sadness, pain, happiness, emotion, and hopelessness, and they responded appropriately to the stimuli and related cues when presenting emotional stimuli. This ability to recognition of facial expressions had a positive effect on their adaptive functions. On the other hand, autistic children have evident stability disorders in communication skills that influence their verbal and nonverbal capacities. This damage causes the individual to use quantitative eye contact and communication strategies. Because of this, the ability to pay attention to the look at others and perception visual cues from other people's faces is defective in children with autism. Spontaneous communication does not include developmental

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in most children, and they need to be taught these skills. According to Poushneh et al. reciprocal imitation, one of the communication skills, is used to increase the interactions of autistic children (13). Probably because of this, the children in the present study improved their eye contact and nonverbal communication after playing computer games. However, the physical structure of the computer causes individual use. Individuals have a personal computer and spent more time alone and less time spend with family and friends (19). This isolation and loneliness might be the reason for the reduction of the children's social communication.

The limitations of this study included lack of the follow-up test and using non-random sampling. Therefore, we recommend that researchers increase the validity of results and the power of generalizing to society in future research by using random sampling, increasing the sample size, and follow-up tests. Finally, further research is suggested to focus on the motivational effectiveness of Emo Game computer games. Because according to the therapist's observations and repeated parental feedback, the motivational and enjoyable dimension of Emo Game computer game intervention had increased for children with autism.

Conclusion

It seems that Emo Game computer games training promotes emotion regulation in children with autism disorder. Therefore, parents, counselors, and therapists can use this intervention as a stable treatment method to improve the emotion regulation of children with autism disorder along other treatments.

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