journal of
Adolescent and Youth Psychological Studies
www.jayps.iranmehr.ac.ir

Spring (April) 2023, Volume 4, Issue 1, 38-48

# Comparative Study of Cognitive Bias and Mental Imaging Modifications on Verbal Memory and Vision of Students

**Maryam. Ashab Sohof[1], Vida Sadat. Razavi Nematollahi*[2], Mahshid. Tajrobehkar[3] & Zahra. Zeinoddiny Meimand[4]**

1. PhD student in educational psychology, Kerman branch, Islamic Azad University, Kerman, Iran
2. Assistant Professor, Department of Psychology and Educational Sciences, Kerman Branch, Islamic Azad University, Kerman, Iran
3. Assistant Professor, Department of Psychology and Educational Sciences, Bahnar University, Kerman, Iran.
4. Assistant Professor, Department of Psychology and Educational Sciences, Kerman Branch, Islamic Azad University, Kerman, Iran

***ARTICLE INFORMATION***

**Article type**
Original research
Pages: 38-48

Corresponding Author's Info
Email:
vidarazavi2010@yahoo.com

**Article history:**
Received: 2022/07/29
Revised: 2023/04/18
Accepted: 2022/11/08
Published online: 2023/04/22

**Keywords:**
*Learning, cognitive bias modulation, mental imagery, visual memory, verbal memory.*

***ABSTRACT***

**Background and Aim:** The present study was carried out with the aim of a comparative study of cognitive bias adjustment training and mental imagery on the verbal and visual memory of female students of the first year of high school. **Methods:** The present study was designed and implemented as an experimental study with a pre-test and post-test design and with a control group. Subjects were randomly replaced in two experimental groups and one control group. The data was obtained using the Wechsler memory test, which was performed individually. Then, the group of cognitive bias adjustment sessions and Simonton's guided mental imagery (Karami & Moradi, 2009) were exposed to different trainings during 8 90-minute sessions, while the control group remained without any intervention. After the training of the experimental groups, the Wechsler test was again performed on the 3 groups. The data were analyzed using repeated measure analysis of variance, Bonferroni post hoc test and SPSS23 software. **Results:** The results showed that the effect of cognitive bias adjustment training and mental imagery on verbal and visual memory is positive and significant, and according to the significance level of this test (p=0.699), it can be concluded that there is a difference between the effect of cognitive bias adjustment training and mental imagery on memory. There is no significant difference between students verbally and visually. **Conclusion:** Teaching different ways of learning in students will have a significant contribution to their school progress due to the greater sensitivity to this segment of the society.



**How to Cite This Article:**
Ashab Sohof, M., Razavi Nematollahi, V., Tajrobehkar, M., & Zeinoddiny Meimand, Z. (2023). Comparative Study of Cognitive Bias and Mental Imaging Modifications on Verbal Memory and Vision of Students. *jayps*, 4(1): 38-48

## Introduction

Memory is one of the most important fundamental processes studied over time, partly due to its educational implications and impact on daily life activities. Short-term memory is a combination of limited storage and control processes, long-term memory as unlimited information storage, and working memory as temporary storage and manipulation of information (Delapena Alvarez, 2012). Memory assessment involves measuring a wide range of memory functions, whether verbal, linguistic or non-verbal (Morrer, 2013). Contributions made by scientific studies related to memory show that, on the one hand, memory is a superior psychological process that is distributed throughout the brain as complex neural networks. On the other hand, there are different types of memory, in such a way that performance and execution are different in each type of memory (Delapena Alvarez, 2012). Working memory (WM) involves the ability to retain and manipulate information in the mind. Neuroimaging studies have shown that in the absence of primary motor activation, secondary motor areas are activated during WM for verbal content (eg, words or letters). This activation pattern may support an internal speech mechanism that supports phonological practice (Liao et al., 2014). Working memory (WM) provides the stability necessary for high-level cognition (Spock et al., 2017). Working memory (WM) is a limited-capacity cognitive system whose function is to maintain information in an active manner to facilitate complex cognitive tasks including language comprehension, learning, abstract thinking, problem solving, understanding the meaning of complex texts, and planning verbal communication. (Baldacchino et al., 2019). Verbal short-term memory has been specifically linked to learning phonetic forms of new words (Delapena Alvarez, 2012; Baldacchino et al., 2019). The division of memory into types of sensory, short-term and long-term memory was first proposed by Atkinson and Shifrin (1968). Sensory memory is responsible for primary perceptual processing by identifying stimuli. The role of attention in sensory memories has often been overlooked (Vandenbroek et al., 2011; Botha et al., 2019). If the information entered from the sensory recording memory is carefully considered, it is entered into the short-term memory and stored for a maximum of 30 seconds (Al-Shahrani, 2017). Robinson (1995) considers the meaning of attention to mean recognition by practice in short-term memory before encoding in long-term memory (Al-Shahrani, 2017). Memory span is the number of items (numbers, letters, or words) that a person can remember in order after encountering them once, which is usually 7±2 (between 5 and 9 pieces) (Witt et al., 2019). Since it has a limited storage capacity (Al-Shahrani, 2017), it is possible to improve the capacity of short-term memory with the intersection method (Peng et al., 2019). Human visual memory is significant and essential for cognition and is still one of the main fields of human cognition (Shargin, 2018). Visual working memory (VWM) is a short-term memory system that stores visual representations of stimulus inputs. It serves as a surrogate for many cognitive processes and tasks, including the ability to determine locations embedded in distractors, to understand and reason about visual representations, and to detect changes in visual scenes (Amundsen et al., 2014). The information received and remembered through the channel of the sense of sight is called visual memory, and the information received and remembered through the channel of the sense of hearing is called verbal memory. Baddeley and Lugi (1999) and Mammarella et al. (2008) stated that visual memory information includes dimensions such as color and shape, and spatial memory information includes the capacity to understand, reason, and remember spatial relationships between objects (Baldacchino et al., 2019). Verbal working memory is often studied in the laboratory using Sternberg's task (Sternberg, 1966) and consists of three parts: A: Encoding stage where visually presented information is transformed into a mental representation. B: Maintenance stage, where this information is practiced with a short delay. and c: the retrieval phase during which a probe is presented and compared with the encoded information. Visual working memory (VWM) is one of the most important units of the information processing system, but it only stores a very limited amount of information (only a maximum of 3~4 simple objects can be stored in VWM at the same time). This limited capacity requires that while efficiently selecting task-related information, task-irrelevant information is also filtered (feature-based filter, color, etc.) (Zhou, Yin, Chen, Ding, Gao, & Shen, 2011). Based on a

working memory model, researchers have studied children's visual and verbal memory and concluded that children pay more attention to visual cues that are transferred from short-term memory to long-term memory in the form of a visual code. On the other hand, mental images are temporary spatial representations in working memory that are created from mental representations in long-term memory. On the other hand, Berdner, Olver, and Greenfield (1966), Piaget and Inhalder (1971), and Kaslin (1991) state that children at an early age first use mental imagery to present information to memory (Bozorg Manesh & Abdullahi, 2012). The mental image is the reconstruction of the physical world beyond the reach of a human, and in his mind (Eysenck and Brisbart, 2018). A mental image is the presentation of an image that is similar to what one sees in the real world and is often thought to be identical to visual imagination (Vertoli, Kelly, & Davis, 2018). Research has shown that the more scientifically advanced a participant is, the more importance they place on visualization (Stewart, 2019). The researches of Marmor (1975 and 1977), Kiel et al. (1986) confirm that preschool children use the same mental imagery processes as adults. In contrast to some other researches (Dean and Harvey (1979), Dean, Dohe and Green (1983), Dick and Schwarzer (1982), Kaslin (1990 and 1976)) stated that the reaction time of children increased gradually. These results It shows qualitative differences in the process of mental imagery in preschool and older children (Leeder, Griffis, Hoyes, & Goodman, 2018).

Abstract cognitive biases pose a serious challenge to rational accounts of human cognition and arise from people's use of rapid, but fallible, cognitive strategies (Leeder, Griffis, Hoyes, & Goodman, 2018). Prejudice is a form of "premature judgment" about matters of which we have no direct, complete, and sufficient knowledge. Allport (1979) described prejudice as a positive or negative feeling toward a person or thing prior to direct experience that is not based on the person or thing. Bias formation is considered an adaptive cognitive process that helps the human mind to process information with the help of categories (Proverbio, Lamastra, & Zani, 2016). Although research has identified some cognitions as enduring factors, little is known about the underlying cognitive processes of these beliefs, and normal processes, such as attention and misinterpretation, may play a role in them (Palermo et al., 2016). Cognitive bias (i.e. biases of negative attention and interpretation) (Ovarat, Grahak and Kaster, 2017).

Cognitive bias is a type of attention in information processing by which people pay more attention to some surrounding stimuli and ignore others (Tarkhan and Ahmadi-Lashki, 2015). Cognitive bias modification refers to strategies that, using regular practice, cause changes in a certain style of cognitive processing (Liu, Li, Han, and Liu, 2017). Cognitive bias adjustment is a method during which biases are designed through educational conditions; to manipulate trauma-related processes; are moderated (Coster, Fox and McLeod, 2009). A cognitive bias modification program refers to strategies that, through regular and repeated practice, aim to change a specific style of cognitive processing that is hypothesized to be involved in unpleasant emotional reactions or disorders (Coster, Fox, & McLeod, 2009). For the first time in 1995, McLeod, in the treatment of attention bias adjustment, showed that by training healthy people, their attention bias towards threats can be increased (Tarkhan and Ahmadi-Lashki, 2015). In all cognitive theories, it is assumed that bias in the information processing process plays an important role in the creation and continuation of emotional disorders (Clark and McManus, 2002). Researches have shown that with training, new learning can be created using mental imagery methods (Bourg-Manesh and Abdullahi, 2012) and adjustment of cognitive bias in people (Clark and Mc-Manus, 2002). The changes made can affect subsequent emotional activities (McLeod, 2012).

Since the performance of visual and verbal memory of students is a very important issue in solving school problems and in every period of education. Based on previous researches, which have been mentioned, with mental imagery training and adjustment of cognitive bias, we can see impressive results in the performance of students' visual and verbal memory. Since the research gaps in this field and the examination of the superior role of each of the above methods on students' verbal and visual memory are evident, the necessity of this study was revealed. If the review of the researches has shown that the focus of the previous researches was on one of the above two methods. Therefore, they have not

been able to implement and test a combination of two methods and make a comparison, this research is an alternative in its kind. In general, the results of this research will increase the performance of visual and verbal memory of students, save the cost of education and academic success of students. The difference between the present research and the previous research is in teaching two independent learning methods and presenting the model. The present study seeks to find that the effect of cognitive bias adjustment and mental imagery training programs on students' verbal and visual memory is different. Therefore, based on previous researches, we can conclude that the performance of students' visual and verbal memory is a very important issue, and with mental imagery training and adjustment of cognitive bias, we will achieve significant results in the performance of students' visual and verbal memory. In general, the results of this research will increase the performance of visual and verbal memory of students, save the cost of education and academic success of students. The difference between the present research and the previous research is in teaching two independent learning methods and presenting the model.

Although substantial literature has grown on the interactions between cognitive state and mental representations with visual and verbal memory performance, the magnitude of this effect remains unclear. The present study seeks to find that the effect of cognitive bias adjustment and mental imagery training programs on students' verbal and visual memory is different.

## Method

The research design of this research is of experimental type and using the pre-test and post-test method with the reference group. In this research, due to the time limitation and the difficulty of conducting the test method while observing the minimum sample size, a sample consisting of 45 students over 15 years of age in the first year of high school in Yazd city was selected by cluster sampling method. Finally, they were replaced in 2 experimental groups and 1 control group. At first, a survey of the subjects was conducted with a pre-test. The experimental groups were trained on independent variables, and at the end of the training, a post-test was taken from all the subjects, and finally, the pre-test and post-test data of the experimental groups were evaluated and analyzed with the control group by relevant statistical methods. After obtaining the necessary permits from the university, the first secondary girls' schools of Yazd city were approached and after obtaining the agreement and cooperation of the principals and teachers; The students were examined, then the students who met the criteria for entering the research were selected and randomly divided into three groups (20 people in each group). The first group was cognitive modulation, the second group was mental imagery, and the third group was the control group. All participants of all three groups were pre-tested and their pre-test scores were recorded. Adjustment of cognitive bias during 8 sessions of 90 minutes and mental imagery during 8 sessions of 90 minutes were held by the researcher, during the training sessions, no intervention was done for the control group. The environmental conditions were tried to be the same for both experimental groups and the meetings were held once a week in the afternoons. A post-test was taken from the participants one week after the sessions. In the case of the control group, after the end of the research, if they wanted, the trainings that were given to the experimental groups were also presented to them. After the completion of the sessions and the implementation of the post-test, the data was analyzed by the SPSS software with the statistical method of analysis of variance with repeated measurements.

## Tools

**1. Wechsler memory test.** Wechsler's memory test (W.M.S) is used as an objective scale to evaluate memory. This test has 7 subscales, each subtest is dedicated to measure a component of memory, and the sum of the scores gives the individual's memory score. Uraki (1995) reported the reliability of this test based on Cronbach's alpha coefficient of 0.67. Azarnia (2003) also implemented this test on 50 subjects and obtained its reliability through Cronbach's alpha of 0.64. Factor analysis has been used to obtain credibility, and 6 factors were identified in the factor analysis of this test, which was conducted with the M3 and ML methods. Also, 5 combined scores of verbal active memory, visual active memory, general memory, attention and concentration, and delayed recall are mentioned in this tool (Orangi et al., 2002). In the present study, a combination of logical memory and association learning and visual active memory were used to obtain verbal active memory. Cronbach's alpha reported in the present study was 0.89 for visual working memory and 0.77 for verbal working memory.

**2. Cognitive bias adjustment sessions.** Adjustment of cognitive bias in this research includes familiarization, identification and evaluation of cognitive biases and teaching methods to evaluate them in a balanced and positive way in life situations by teaching incomplete scenarios of Matthews and Mackintosh. Subjects were exposed to

incomplete scenarios during 8 sessions and were asked to describe their feelings about the stated situation. Then, with the help of the researcher, their cognitive biases are adjusted and positivized. The description of the training sessions is as follows:

**Table 1. Cognition bias modification sessions Table**

| Session | The content of the meetings |
|---|---|
| 1 | It is your friend's birthday party and all your other friends are invited to this party but you are not invited to this party. |
| 2 | You won the first place in the school's scientific competition and the prize for the best participants was in Urdu, but suddenly the Urdu program is canceled by the school. |
| 3 | You enter the house and your parents start laughing as soon as you enter. |
| 4 | You are sitting in class. You ask your teacher a question, and after you another friend asks the teacher his question, and your teacher answers your friend's question and quickly enters his subject. |
| 5 | You are invited to a party at your friend's house, but the host goes towards the rest of the guests upon your arrival. |
| 6 | As it happened, you arrived late to the school, Nazem is standing next to the entrance door of the school and when he sees you, he starts reprimanding and reprimanding you. |
| 7 | Your parents have returned from shopping and are giving the food they bought to your little brother or sister. |
| 8 | The family has arranged a one-day travel plan and they ask your opinion to choose a place, but in the end they choose the place they have chosen for a one-day trip. |

**3. Mental imagery.** Mental imagery in this research is training to imagine objects, stimuli and situations in the mind and when they are not accessible with Simonton's guided mental imagery method (cited by Karami and Moradi, 2009). Subjects will be exposed to the following training in 8 sessions of 90 minutes as described below:

**Table 2. Mental imaging sessions**

| Session | The content of the meetings |
|---|---|
| 1 | Students are asked to close their eyes and imagine that they have a lime in their hand. Cut it with a knife and express their physical and physiological changes, the secretion of saliva, the taste of lemon and the smell of lemon. |
| 2 | Teaching relaxation or muscle relaxation to students. |
| 3 | Recreating the memory of an exciting experience such as sitting on the beach and teaching them to recreate the feelings they had at that moment (hearing the children's voices and the waves of the sea, the cool touch of the breeze on the cheeks). |
| 4 | Reconstructing a negative emotional experience (such as test anxiety) and recalling and recalling associated emotions. |
| 5 | Teaching how to replace an unpleasant memory with a pleasant one. |
| 6 | Training of mnemonics and how to use it in the mind. |
| 7 | Learning to work with the palm and visualizing a color that reminds of stress and replacing it with a color that is a source of relaxation. |
| 8 | Visualize the healing ball to reduce tension in people. |

## Results

The mean and standard deviation of age in the cognitive bias adjustment training group was 16.5 (3.7), in the mental imagery training group it was 1.16 (3.3) and in the control group it was 16.7 (3.9). The average and standard deviation of the verbal memory and visual memory scores of high school students in different stages of evaluation, divided into experimental groups 1 (cognitive bias adjustment training), experimental 2 (mental imagery training), and evidence are presented in Table 3.

**Table 3. Descriptive findings of verbal and visual memory variables of high school students in experimental and control groups**

| variable | stage | | N | standard ±Mean deviation | Min | Max |
|---|---|---|---|---|---|---|
| Verbal memory | cognition bias modification training | pre-test | 15 | 25/33 ± 2/54 | 20/5 | 29 |
| | | post-test | 15 | 31/00 ± 4/72 | 23/5 | 41 |
| | mental imaging training | pre-test | 15 | 24/57 ± 3/03 | 19 | 32 |
| | | post-test | 15 | 28/30 ± 1/93 | 25 | 32 |
| | control | pre-test | 15 | 25/37 ± 2/71 | 20 | 31 |
| | | post-test | 15 | 28/73 ± 2/73 | 24 | 35/5 |
| Visual memory | cognition bias modification training | pre-test | 15 | 9/47 ± 1/06 | 7 | 11 |
| | | post-test | 15 | 13/27 ± 0/88 | 11 | 14 |
| | mental imaging training | pre-test | 15 | 9/13 ± 1/46 | 6 | 11 |
| | | post-test | 15 | 12/93 ± 0/96 | 11 | 14 |
| | control | pre-test | 15 | 9/27 ± 1/58 | 6 | 11 |
| | | post-test | 15 | 10/73 ± 1/22 | 8 | 12 |

As seen in Table 3, the average verbal and visual memory of high school students of the experimental groups in the pre-test phase are different from the post-test phase. However, in the control group, the scores in scores in the verbal and visual memory variable of high school students in the two stages of evaluation (pre-test and post-test) are not much different.

**Table 4. The results of the normal distribution of scores and homogeneity of variances test**

| variable | group | K-S | | | Levene's test | | | Mauchly | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Df | Statistics | Sig. | Df | Statistics | Sig. | Df | Statistics | Sig. |
| Verbal memory | cognition bias modification | 15 | 0/731 | 0/629 | 28 | 1/50 | 0/245 | 3/15 | 0/84 | 0/16 |
| | mental imaging | 15 | 0/846 | 0/424 | | | | | | |
| | control | 15 | 0/620 | 0/845 | | | | | | |
| Visual memory | cognition bias modification | 15 | 0/973 | 0/304 | 28 | 2/33 | 0/18 | 2/69 | 0/91 | 0/27 |
| | mental imaging | 15 | 0/620 | 0/845 | | | | | | |
| | control | 15 | 0/437 | 0/947 | | | | | | |

Multivariate covariance analysis was done to identify which of the observed differences is significant. The results of this analysis are presented in Table 4. This table shows that cognitive bias adjustment training and mental imagery were significantly effective on visual memory (F=264.26, P<0.001) and the amount of this effect was 0.57. Also, the results showed that the effect of cognitive bias adjustment training and mental imagery on verbal memory (F=2.726, P=0.043) was significant and the amount of this effect was 0.13. Therefore, the null hypothesis that cognitive bias adjustment training and mental imagery do not increase the performance of students' visual and verbal memory, the counter hypothesis that cognitive bias adjustment training and mental imagery increase the performance of learners' visual and verbal memory is confirmed.

**Table 5. Summary of the simple analysis of variance test of ingroup and outgroup effects of visual working memory**

| | Change source | SS | Df | MS | F | Sig. | Eta |
|---|---|---|---|---|---|---|---|
| **Between** | Group | 51/3 | 1 | 51/3 | 6/72 | 0/015 | 0/194 |
| **Within** | Factor | 107/3 | 1/38 | 77/3 | 215/3 | 0/001 | 0/885 |
| | Factor&Group | 29/3 | 1/38 | 21/1 | 58/8 | 0/001 | 0/678 |

The results of the simple analysis of variance with repeated measures within the case based on Greenhouse Geisser, show that the main effect of the factor is significant at the 0.01 level (p = 0.001, F = 215.3, Greenhouse-Geisser = 107.3). This result means a significant difference exists between the factor score (pre-test, post-test and follow-up) of the research variables regardless of the group. Also, the interaction effect of the group with the factor (measurement steps) is significant at the 0.01 level (p = 0.001, F = 58.8, Greenhouse-Geisser = 29.3). In other words, there is a significant difference between at least two stages of visual active memory between the intervention group and the control group.

**Table 6. Summary of simple analysis of variance test of ingroup and outgroup effects of verbal working memory**

| | Change source | SS | Df | MS | F | Sig. | Eta |
|---|---|---|---|---|---|---|---|
| **Between** | Group | 157/3 | 1 | 157/3 | 34/05 | 0/001 | 0/549 |
| **Within** | Factor | 232/8 | 1/49 | 155/5 | 30/1 | 0/001 | 0/518 |
| | Factor&Group | 158/02 | 1/49 | 105/5 | 20/4 | 0/001 | 0/422 |

The results of the simple analysis of variance with repeated measures within the case based on Greenhouse-Geisser, show that the main effect of the factor is significant at the 0.01 level (p=0.001, F = 1.30, Greenhouse-Geisser = 232.8). This result means a significant difference exists between the factor score (pre-test, post-test and follow-up) of the research variables regardless of the group. Also, the interaction effect of the group with the factor (measurement steps) is significant at the 0.01 level (p=0.001, F=20.4, Greenhouse-Geisser=158.02). In other words, there is a significant difference between at least two stages of verbal active memory between the intervention group and the control group.

**Table 7. Bonferroni's test to compare three groups in visual working memory**

| **stage** | variable | group | group | Mean diff. | sig |
|---|---|---|---|---|---|
| post-test | visual working memory | cognition bias modification | mental imaging | -0/375 | 1 |
| | | cognition bias modification | control group | -6/83 | 0/001 |
| | | mental imaging | control group | 6/45 | 0/001 |
| follow-up | visual working memory | cognition bias modification | mental imaging | -0/333 | 1 |
| | | cognition bias modification | control group | -7/00 | 0/001 |
| | | mental imaging | control group | -6/66 | 0/001 |

According to the results of the Bonferroni test in Table 7, there is no significant difference in the post-test in the variable of visual active memory between cognitive bias adjustment and mental imagery (p<0.05). Also, a statistically significant difference was reported between cognitive bias adjustment and mental imagery in the control group (P<0.01). In other words, both methods had an effect on the visual active memory in the intervention subjects, and these two interventions did not have a significant difference in terms of effectiveness in improving the visual active memory. These results are also seen in the follow-up of both interventions.

| Table 8. Bonferroni's test to compare three groups in verbal working memory | | | | | |
|---|---|---|---|---|---|
| **stage** | variable | group | group | Mean diff. | sig |
| **post-test** | verbal working memory | cognition bias modification | mental imaging | 22/7 | 0/001 |
| | | cognition bias modification | control group | 27/8 | 0/001 |
| | | mental imaging | control group | 5/08 | 0/039 |
| **follow-up** | verbal working memory | cognition bias modification | mental imaging | 23/4 | 0/001 |
| | | cognition bias modification | control group | 28/2 | 0/001 |
| | | mental imaging | control group | 4/83 | 0/033 |

The results of Table 8 showed that in the post-test there is a significant difference in verbal active memory between the two groups of cognitive bias adjustment and mental imagery ($p<0.01$). Also, a statistically significant difference was reported between cognitive bias adjustment and mental imagery in the control group ($P<0.05$). In other words, both methods have affected improving verbal, active memory and these two interventions had a significant difference in terms of effectiveness on verbal, active memory. These results are also seen in the follow-up of both interventions.

## Conclusion

The present study was conducted with the aim of a comparative study of cognitive bias adjustment training and mental imagery on the verbal and visual memory of female students of the first year of high school. Based on a model of working memory, researchers have studied visual and verbal memory of children. They have come to the conclusion that children pay more attention to signs that are transferred from short-term memory to long-term memory in the form of visual code (Bozorgmanesh and Abdullahi, 2012). children at early ages; First, they use mental imagery to present information to memory (Piaget, 2013). According to theorists, the mental image is present from birth. The characteristics of the environment, data structures and processing contents of the mental image system are intrinsically organized and fixed (Salimi et al., 2014). Advances in mental imagery do not include fundamental qualitative changes in the nature of imaging processes or representational methods, but instead increase the ability to evaluate and use mental imagery more effectively for a wider range of subjects (Bozorgmanesh and Abdullahi, 2012).

The present study was designed and implemented with the aim of explaining and investigating the effectiveness of cognitive bias adjustment and mental imagery on the visual and verbal memory of female students of the first year of high school in the city of... The results of the study showed that the effect of adjusting cognitive bias and mental imagery on students' visual and verbal memory is significant. The results are in line with the data obtained from the study of the effect of mental imagery through visual arts training on visual and verbal memory performance of first grade male and female elementary school students (Bozorgmanesh and Abdullahi, 2012). The study of Salimi et al. also confirms the positive effect of using written representation methods and mental imagery in solving mathematical verbal problems (Salimi et al., 2014). Interventions in the field of positive imagery in skill acquisition also obtained useful results and showed that negative imagery will lead to a decrease in performance (Qurbani et al., 2013).

The use of mental imagery, apart from education and school systems, has also been investigated in patients. In this regard, the interventions of Narimani and colleagues in the study of patients with schizophrenia showed that there is a significant relationship between verbal memory and information processing or recognition of facial expression of emotion (Narimani, Qasimpour, and Abolqasmi, 2013). Moreover, in children with learning disorders, there are deficits in memory and recognition of emotions and facial expressions (Operto et al., 2020). The results indicate a greater effect on visual memory performance, which is contrary to the intervention results of Bozorgmanesh and Abdullahi (Bozorgmanesh and Abdullahi, 2012). A group of studies point to the role of gender in

the significance of the results, and point to the better performance of boys in visual memory and the better performance of girls in verbal recall (Bozorgmanesh and Abdullahi, 2012).

Studies have shown that cognitive bias has the ability to change and adjust, and as a result, these changes can affect subsequent emotional activities as well (Ahmari, Salehi Ferderdi and Saber, 2015). The results of the statistical analysis of the data have shown that the cognitive rehabilitation treatment of working memory has improved the behavioral symptoms of children with attention deficit/hyperactivity disorder (Najjarzadegan, Nejati and Amiri, 2016). Bias adjustment has clinical applications in reducing the symptoms of social anxiety disorder (Liu et al., 2017), treating social anxiety (Ahmari, Salehi Farderdi, and Saber, 2015) and reducing the intensity of obsessive symptoms, beliefs, and behaviors (Dalir et al., 2016). Data analysis in a study of archival psychological data consisting of a composite pediatric clinical sample noted that verbal knowledge is specifically related to encoding and unrelated to memory maintenance or retrieval stages (Jordan, Tyner, & Heaton, 2013).

The results of the present research have shown that both mental imagery training and cognitive bias adjustment will increase students' visual and verbal memory performance, but they will not have a significant advantage over each other. Of course, there was no follow-up in this plan. Of course, this plan has been shown apart from the subjects' education, age and gender. The mentioned program can play an effective step in teaching and learning of students. Of course, in the next researches, other steps should be taken in different age ranges, different genders, in order to find other dimensions of the desired effect.

## Conflict of Interest

According to the authors, this article has no financial sponsor or conflict of interest.

## References

Ahmadabadi Arani, N., Ahmadi Hedayat, H., & Farmahini Farahani, M. (2019). Analysis and criticizing of the implication of multi-cultural education with an emphasize on Michel Foucault opinions. Research in Curriculum Planning, 16(61), 127-145.

Ahmari, M., Salehi Fadardi, J., Yazdi, S. A. A., & Saber, H. (2016). Effects of a modern cognitive bias modification program on attentional biases and social anxiety symptoms in socially-anxious students. Journal of Fundamentals of Mental Health, 18)1.(

Alshahrani, A. (2018). Comparison of three models dealing with working memory and its dimensions in Second Language Acquisition. International Journal of Applied Linguistics and English Literature, 7(1), 38-48.

Amundsen, M. L., Garmannslund, P. E., & Stokke, H. (2014). Visual Working Memory-Gender and Age Differences. European Journal of Educational Sciences, 1(3), 1-17.

Asadi, A., Kalantari, K., & Choobchian, S. (2013). Structural analysis of factors affecting agricultural sustainability in Qazvin Province, Iran. Journal of Agricultural Science and Technology, 15(1), 11-22.

Baldacchino, A., Tolomeo, S., Balfour, D. J., & Matthews, K. (2019). Profiles of visuospatial memory dysfunction in opioid-exposed and dependent populations. Psychological medicine, 49(7), 1174-1184.

Blinkhorn, F., Brown, N., Freeman, R., Humphris, G., Martin, A., & Blinkhorn, A. (2012). A phase II clinical trial of a dental health education program delivered by aboriginal health workers to prevent early childhood caries. BMC Public Health, 12, 1-8.

Botta, F., Martín-Arévalo, E., Lupiáñez, J., & Bartolomeo, P. (2019). Does spatial attention modulate sensory memory?. PloS one, 14(7), e0219504.

Bozorgmanesh, A., & Abdollahi, M. H. (2012). The Effect of Mental Imagery on Visual and Verbal Memory Performance in Students□. Journal of Psychology, 16, 3-15.

Clark, D. M., & McManus, F. (2002). Information processing in social phobia. Biological psychiatry, 51(1), 92-100.

Dalir, M., Alipour, A., Zare, H., & Farzad, V. (2016). The effect of cognitive bias modification therapy on symptoms of obsessive-compulsive disorder: Comparison efficacy of cognitive bias modification therapy and group cognitive-behavioral therapy. Clinical Psychology Studies, 6(21), 1-25.

Daryapour, E., Dortaj, F., Abbaspour, A., Saadipour, E., & Delavar, A. (2020). Effective factors on developing research culture in elementary education: study with the phenomenology approach. Journal of school psychology, 9(1), 30-53.

Everaert, J., Grahek, I., & Koster, E. H. (2017). Individual differences in cognitive control over emotional material modulate cognitive biases linked to depressive symptoms. Cognition and Emotion, 31(4), 736-746.

Eysenck, M. W., & Brysbaert, M. (2018). Fundamentals of cognition. Routledge.

GHORBANI, A. H., GHOTBI, V. A., & PARHIZKAR, K. O. J. (2013). Comparing of the effect PETTLEP mental imagery and physical practice on the acquisition and retention skill of dart throwing.

Jordan, L. L., Tyner, C. E., & Heaton, S. C. (2013). Cognitive predictors of verbal memory in a mixed clinical pediatric sample. Behavioral Sciences, 3(3), 522-535.

Koster, E. H., Fox, E., & MacLeod, C. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. Journal of abnormal psychology, 118(1), 1.

Liao, D. A., Kronemer, S. I., Yau, J. M., Desmond, J. E., & Marvel, C. L. (2014). Motor system contributions to verbal and non-verbal working memory. Frontiers in human neuroscience, 8, 753.

Lieder, F., Griffiths, T. L., M. Huys, Q. J., & Goodman, N. D. (2018). The anchoring bias reflects rational use of cognitive resources. Psychonomic bulletin & review, 25, 322-349.

Liu, H., Li, X., Han, B., & Liu, X. (2017). Effects of cognitive bias modification on social anxiety: A meta-analysis. PloS one, 12(4), e0175107.

MacLeod, C. (2012). Cognitive bias modification procedures in the management of mental disorders. Current Opinion in Psychiatry, 25(2), 114-120.

Morere, D. A. (2013). The signed verbal learning test: Assessing verbal memory of deaf signers. Sign Language Studies, 14(1), 39-57.

Najarzadegan, M., Nejati, V., & Amiri, N. (2016). Investigating the predictive role of working memory in risky decision-making in children with attention deficit and hyperactivity disorder. KAUMS Journal (FEYZ), 19(6), 504-510.

Narimani, M., Ghasempour, A., & Abolghasemi, A. (2013). Examination of relationship between verbal and non-verbal memory, informationprocessing, response inhibition with facial expression recognition in patients with schizophrenia. Research in Clinical Psychology and Counseling, 2)2.(

Operto, F. F., Pastorino, G. M. G., Stellato, M., Morcaldi, L., Vetri, L., Carotenuto, M.,... & Coppola, G. (2020). Facial emotion recognition in children and adolescents with specific learning disorder. Brain Sciences, 10(8), 473.

Palermo, L., Piccardi, L., Nori, R., Giusberti, F., & Guariglia, C. (2016). The impact of ageing and gender on visual mental imagery processes: A study of performance on tasks from the Complete Visual Mental Imagery Battery (CVMIB). Journal of Clinical and Experimental Neuropsychology, 38(7), 752-763.

Pang, J., Tang, X., Nie, Q. Y., Conci, M., Sun, P., Wang, H.,... & Luo, J. (2019). Resolving the Electroencephalographic Correlates of Rapid Goal-Directed Chunking in the Frontal-Parietal Network. Frontiers in Neuroscience, 13, 744.

Peña Álvarez, C. D. L. (2012). Inteligencia verbal y memoria verbal en escolares disléxicos de primaria. Revista española de orientación y psicopedagogia.

Proverbio, A. M., La Mastra, F., & Zani, A. (2016). How negative social bias affects memory for faces: An electrical neuroimaging study. Plos one, 11(9), e0162671.

Salimi, M., SADIPOUR, E., Delavar, A., & MALEKI, H. (2014). Comparison of training effects in imagery strategies of mental imagery of think-aloud of written representation and motor representation on the performance of elementary students in solving verbal math problems.

Schurgin, M. W. (2018). Visual memory, the long and the short of it: A review of visual working memory and long-term memory. Attention, Perception, & Psychophysics, 80, 1035-1056.

Spaak, E., Watanabe, K., Funahashi, S., & Stokes, M. G. (2017). Stable and dynamic coding for working memory in primate prefrontal cortex. Journal of neuroscience, 37(27), 6503-6516.

Stuart, M. T. (2019). Everyday scientific imagination: A qualitative study of the uses, norms, and pedagogy of imagination in science. Science & Education, 28(6-7), 711-730.

Tarkhan, M., & Ahmadi Lashki, G. (2015). The Relationship Between Self-focus Cognitive Bias and Responsibility with Social Adjustment of Women. Social Cognition, 3(special), 97-108.

Vandenbroucke, A. R., Sligte, I. G., & Lamme, V. A. (2011). Manipulations of attention dissociate fragile visual short-term memory from visual working memory. Neuropsychologia, 49(6), 1559-1568.

Vertolli, M. O., Kelly, M. A., & Davies, J. (2018). Coherence in the visual imagination. Cognitive Science, 42(3), 885-917.

Witt, J. A., Coras, R., Becker, A. J., Elger, C. E., Blümcke, I., & Helmstaedter, C. (2019). When does conscious memory become dependent on the hippocampus? The role of memory load and the differential relevance of left hippocampal integrity for short-and long-term aspects of verbal memory performance. Brain Structure and Function, 224, 1599-1607.

Zhou, J., Yin, J., Chen, T., Ding, X., Gao, Z., & Shen, M. (2011). Visual working memory capacity does not modulate the feature-based information filtering in visual working memory. PLoS One, 6(9), e23873.