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Attention Bias Modification for Social Anxiety Disorder: A Randomized Controlled Trial

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Abstract

Background: Social anxiety disorder, one of the most common anxiety disorders, is known as a chronic psychiatric disorder.
Objectives: The present study is aimed at investigating the effects of computer-based attention training on attention bias modification for social anxiety disorder.
Methods: This randomized controlled trial was performed on 30 students who suffered from social anxiety disorder. All of them filled out the social phobia inventory (SPIN; Connor et al.), Hamilton depression rating scale (HDRS), and social anxiety disorder severity questionnaire (SCSQ) and attended a clinical interview. The participants were randomly assigned to an experimental group (n = 15) and a control group (n = 15), and then they took part in a computer-based pretest program of attention bias measurement (ABM). The experimental group attended 10 sessions of computer-based attention control training program. Both of the groups participated in a computer-based posttest program of ABM. The data were analyzed using the analysis of covariance.
Results: Our findings indicated that the computer-based attention control training contributed to reducing attention bias towards the angry (Eta Square = 0.34), surprised (Eta Square = 0.23), and happy (Eta Square = 0.19) expressions, while it did not have any effects on disgusted, fearful, and sad expressions.
Conclusions: Attention training program is an effective method to modify attention bias towards some of the emotional effects and can be employed in therapeutic interventions.

Keywords: Attention, Anxiety, Phobia, Social

1. Background

Social anxiety disorder, one of the most common anxiety disorders, is known as one of chronic psychiatric disorders. The concept of social anxiety disorder is specified by a significant amount of fear in one or more social situations (e.g., speech). People with social anxiety disorder are fearful and try to stay away from any social situations where they think they may have a shameful behavior or face others' negative assessment. The 12-month prevalence of this disorder is reported to be 2% to 5% and it is observed 1.5 to 2.2 times more in women than in men (1). Social anxiety disorder becomes more complex when experienced with other psychiatric conditions, including suicidal thoughts and committing suicide, insomnia, mood disorders, and substance abuse problems (2).

From a cognitive perspective, anxious people are biased in their cognitive systems (3). One of the fundamental components of human cognitive capacities is continuous attention (4). The general concept of attention bias is that more attention is devoted to threatening stimuli compared to neutral ones (5). Attentional biases are the core of current cognitive behavioral patterns of social anxiety (6). These biases are due to the impact of individual's judgments regarding the environmental cues instigating anxiety in social situations. Accordingly, people with social anxiety show attentional bias in the interpretation of attention and imagination as compared to non-anxious individuals (7).

Attentional bias is often measured by the provided rapid visual stimuli at an early stage of information processing (5). Studies show that there is negative bias in processed incidents (8). Therefore, it is likely that the increase in the attention drawn to the sign of the potential threat would result in overstimulation and maintenance and would even intensify anxiety (9).

Attentional bias towards the sign of threat should be

stopped and thus potentially improve anxiety symptoms (2). Evidence suggests that attention can be manipulated by modifying the dot-probe. However, reducing bias in clinical settings is likely to be considerably more difficult than the change in attention patterns in non-clinical situations (10). Dot-probe task is applied successfully in the treatment of attentional bias among patients with different anxiety disorders, including social anxiety (11, 12).

The dot-probe task generally includes presenting words or images that are visible for a short period of time and then disappear. Studies using dot-probe task encounter negative social evaluation and reformation of desire to bias compared to facial expressions and words among patients with social anxiety disorder (13, 14) and in non-anxious clinical samples. Attention bias modification (ABM) therapy is a promising treatment for anxiety disorders (15). Although numerous treatments for social anxiety disorder have been developed and implemented in recent decades, it is not clear which components in the therapeutic programs should be changed to improve the efficiency of therapy. For example, in many experiments, a target stimulus is offered throughout treatment at a fixed rate.

Although various studies have confirmed the efficacy of these interventions (16), the basic assumption of our study is that by changing the target stimuli (emotional stimuli), attentional bias to stimuli will be probably turned off more quickly. On the other hand, subjects with less sensitivity to such incentives will follow their environment. Another assumption of our study is that various emotional stimuli have different impacts. For example, anger triggers and happiness have different impact levels. It appears that some of these stimuli are more powerful in inducing biased responses. In the present study, based on our first hypothesis, we predict that the effect of the size of therapeutic intervention is more significant than that of the previous methods. Furthermore, in the second hypothesis, we predict that the effect size of therapeutic interventions is different.

2. Objectives

The present study is aimed at investigating the effects of computer-based attention training on attention bias modification for social anxiety disorder.

3. Materials and Methods

3.1. Patients and Settings

This was a single-blind randomized controlled trial where the participants were randomly assigned to receive or not to receive ABM.

One of the researchers administered the ABM program by a computer and via individualized ABM. The reaction time to emotional effects was measured before and after the intervention. The study population included all the students in Semnan University, and the study was performed during 2015 - 2016. First, 300 social anxiety questionnaires were distributed among Semnan University students. According to the scores obtained from the questionnaires, 30 participants who had social anxiety disorders and met the inclusion criteria were enrolled in the study. The inclusion criteria consisted of obtaining scores above 33 in the social anxiety questionnaire (17) and the severity measure for social anxiety questionnaire and scores lower than seven in the Hamilton scale. Clinical interview was employed for the diagnosis of social anxiety disorder. The sample size was estimated 30 by the G*power software and considering the effect size of 0.6, alpha value of 0.05 and test power of 0.89. Thirty individuals were randomly assigned to two groups of experimental (n = 15) and control (n = 15). During the intervention in the ABM group, five participants were excluded due to lack of cooperation. Patients with any evidence of psychiatric emergencies or history of schizophrenia, bipolar disorder, depression, or other mental disorders were excluded from the study. These cases were evaluated via clinical interviews.

3.2. Intervention

To design the test, we utilized six main emotions divided into two categories based on the following values. (A) facial emotional effects with clear value: threatening effects and neutral emotional effects. (B) facial emotional effects with uncertain value. This program was implemented based on a modified version of the original test designed by McLeod et al. 1986.

Pictures of the stimuli (each having six emotional effects and one neutral effect) were prepared. Among the pictures for each expression, the picture corresponding to the desired expression was selected by using a survey among the students. A total of 240 pictures of facial expressions remained. A software was applied to build this program. In this test, the program was designed for emotional and neutral pictures (the size of each picture was 21 $\times$ 16 cm) in pairs with a random arrangement of left-right and right-left next to each other. The order for providing a pair of pictures was designed randomly in 120 attempts. The pictures appeared for five milliseconds. After the presentation of each picture, the probe randomly appeared instead of the neutral stimulus.

The subjects pressed the right key as soon as they saw the sign. Then, the reaction time was measured, and the stabilization sign appeared afterwards. The subjects in the experimental group were individually provided with attention bias measurement software twice a week for 10 ten-

minute sessions. At this stage, we presented 10 blocks with 120 attempts. The rate of threatening emotional effects was approximately 80% in the first session, and the pictures with random arrangement were presented since the seventh session. Thus, from the seventh session up to the tenth session, we gradually reduced the target stimuli until they reached 60%.

3.3. Assessment

3.3.1. Social Phobia Inventory (SPIN)

It was designed by Connor et al. in 2000 to assess social anxiety. SPIN is a self-rated scale that contains 17 items and constitutes three subscales of fear, avoidance, and physiological discomfort. Each material of this questionnaire was scored based on a five-point Likert scale. Hence, the total score of subjects can range from 0 to 68. MacLeod and Clarke reported (18) the reliability of this scale to be 0.78 and 0.89 by the test-retest method in groups diagnosed with social anxiety disorder; they also stated that the Cronbach' alpha coefficient in a group of people for the total scale was 0.94, and it was 0.89 for the fear subscale, 0.91 for prevention, and 0.80 for physiological disorders (17). Abdi reported that the internal consistency using Cronbach's alpha was equal to 0.86, and the reliability was equal to 0.83 by using the test-retest method (19).

3.3.2. Hamilton Depression Rating Scale (HDRS)

It is used by therapists and is designed to assess the severity of depression in patients. A 17-item version of the HDRS was standardized for clinical trials. HDQ is a multidimensional scale, meaning that the score of each item cannot predict the overall score (20). Several studies have evaluated the internal consistency of different versions of HDRS, and the results revealed that it ranges from 0.48 to 0.92. Recent studies have measured the internal consistency coefficient to be 0.83 for the 7-item version of HAM-D-17 and 0.88 for 24-item HAM-D-24 version (21). The validity of HDRS was within the range of 0.65 to 0.90 for the overall scale of severity of depression. In Iran, Gharraee et al. reported the validity of this scale and the Hamilton Anxiety rating scale to be 0.85 and 0.89, respectively (22).

Social anxiety disorder severity questionnaire (SCSQ) includes 10 items assessing the severity of social anxiety symptoms (social phobia) in patients aged 18 years and older. This scale is rated using a five-point Likert scale ranging from 0 = never to 4 = all the time. The total score ranges from 0 to 40, with higher scores indicating greater intensity of social anxiety disorder. The internal consistency of the questionnaire using Cronbach's alpha was equal to 0.71.

Semi-structured clinical interviews were employed for anxiety disorders based on DSM-5.

3.4. Data Collection/Procedure

Randomization was accomplished using a simple coin toss for each participant. A written consent was obtained from each participant. The participants were assigned to either the ABM treatment group or control group. The ABM and test sessions were held by a researcher with an MA in Psychology. The reaction time to emotional effects was measured before and after the intervention.

3.5. Data Analysis

In this study, there was a group variable (experimental group-control) and the dependent variable was reaction time in different emotional effects. Because a pretest-posttest design was applied, first the scores of difference in emotional and neutral stimuli in the pre-test and post-test were obtained and then the analysis of covariance was used. We did not use MANCOVA because all of the emotional effects of the pre-test were covariates for every emotional effect in the post-test and the sample size was too small.

3.6. Ethical Considerations

The present study was approved by the institutional review board (IRB) of Semnan University (IRB no.139422). Participation in the study was voluntary and the participants were free to withdraw from the study at any time without incurring penalty or limitation.

4. Results

The mean age of the participating students was 22 years old and they were aged between 18 and 32 years old. The reaction time to emotional effects in the experimental group from pre-test (516.68) to post-test (461.19) declined at a rate of 55.49%. This decrease was also observed in the control group (43.01). Our findings showed that the greatest reduction in reaction time was to the sad effects and then to the disgusting effects. The reaction time to sad emotional effects in the experimental group declined from pre-test (510. 20) to post-test (436.30) at a rate of 73.9%. This reduction was also noted in the control group (41.87). The reaction time to disgusted effects in the experimental group from pre-test (540.94) to post-test (472.44) declined at a rate of 68.5%. This decrease was also observed in the control group (51.68; Table 1).

A covariance analysis was applied to analyze the data. First, the model assumptions were investigated. Levene's test was employed to test if the samples had equal variance. The results revealed that the equal variance assumption is true for all variables. For the happy emotional effects ($F_{1,23} = 1.55$, $P > 0.05$), the sad emotional effects ($F_{1,23} = 1.04$, $P > 0.05$), anger emotional effects ($F_{1,23} = 0.148$, $P >$

Table 1. The Mean and Standard Deviation of the Reaction Time to Separate Emotional and Neutral Effects[a]

Emotional Effects	Group	Pre-Test	Post-Test
Emotional effects	Experimental	516.68 ± 92.09	466.40 ± 64.17
	Control	509.30 ± 91.38	466.29 ± 57.74
Neutral	Experimental	530.99 ± 102.16	442.29 ± 61.90
	Control	529.60 ± 95.92	487.21 ± 58.30
Happy effects	Experimental	524.19 ± 97.47	470.06 ± 90.63
	Control	513.42 ± 89.36	446.70 ± 130.67
Neutral	Experimental	524.88 ± 101.98	435.06 ± 65.10
	Control	514.50 ± 94.99	487.94 ± 93.02
Sad effects	Experimental	510.20 ± 94.97	436.30 ± 45.98
	Control	499.92 ± 101.95	458.05 ± 63.80
Neutral	Experimental	552.19 ± 118.91	451.65 ± 61.16
	Control	549.27 ± 96.52	497.84 ± 50.60
Furious effects	Experimental	529.14 ± 95.35	472.37 ± 75.67
	Control	508.72 ± 98.72	474.45 ± 76.33
Neutral	Experimental	551.98 ± 115.00	425.18 ± 71.41
	Control	538.44 ± 99.56	490.46 ± 53.3
Disgusting effects	Experimental	540.94 ± 118.17	472.44 ± 83.70
	Control	512.19 ± 88.29	460.51 ± 63.89
Neutral	Experimental	539.44 ± 138.51	451.23 ± 67.48
	Control	505.83 ± 85.10	475.69 ± 72.89
Surprised effects	Experimental	539.82 ± 109.17	543.90 ± 82.48
	Control	510.49 ± 79.05	463.46 ± 67.76
Neutral	Experimental	535.53 ± 94.60	442.54 ± 69.47
	Control	532.29 ± 97.77	489.01 ± 37.15
Afraid effects	Experimental	507.31 ± 87.65	459.56 ± 89.45
	Control	513.14 ± 110.87	474.94 ± 59.49
Neutral	Experimental	555.91 ± 92.79	454.92 ± 71.16
	Control	547.60 ± 128.62	486.98 ± 74.12

[a]Values are expressed as mean ± standard deviation.

0.05), disgusted emotional effects ($F_{1,23} = 0.642$, $P > 0.05$), frightened emotional effects ($F_{1,23} = 0.664$, $P > 0.05$), and surprised emotional effects ($F_{1,23} = 0.012$, $P > 0.05$). The second assumption of the model, that is, the interaction between pre-test and the independent variables were examined. The results showed that the effects of the interaction between pre-test and group were not significant for all the variables. For the happy emotional effects ($F_{2,22} = 1.101$, $p > .05$), the sad emotional effects ($F_{2,22} = 0.319$, $P > 0.05$), the anger emotional effects ($F_{2,22} = 2.35$, $P > 0.05$), the disgusted emotional effects ($F_{2,22} = 0.177$, $P > 0.05$), frightened emotional effects ($F_{2,22} = 0.705$, $P > 0.05$), and surprised emotional effects ($F_{2,22} = 0.792$, $P > 0.05$). Thus, the assumptions were true for all the variables.

The assumption of normality was tested for the happy emotional effects (KS = 0.57, $P > 0.05$), the sad emotional effects (KS = 0.48, $P > 0.05$), the anger emotional effects (KS = 0.46, $P > 0.05$), the disgusted emotional effects (KS = 0.59, $P > 0.05$), frightened emotional effects (KS = 0.68, $P > 0.05$), and surprised emotional effects (KS = 0.61, $P > 0.05$). Thus, the assumptions were true for all the variables.

The results demonstrated that on the whole, there was a significant difference between experimental and control groups regarding the scores of reaction time differences to emotional effects (Table 2). Findings showed a significant difference between experimental and control groups in the angry emotional effect ($P < 0.05$, $\eta^2 = 0.34$), the surprised emotional effect ($P < 0.05$, $\eta^2 = 0.23$), and the happy emotional effects ($P < 0.05$, $\eta^2 = 0.19$). However, the treatment had the highest effect on the angry emotional effect. The proportion of variance in the angry emotional effect explained by the ABM treatment, while controlling for other effects, is 0.34. Also, test results indicated no significant difference between the experimental and control groups in the disgusted emotional effects ($P > 0.05$), the frightened-neutral emotional effects ($P > 0.05$), and the sad-neutral emotional effects ($P > 0.05$).

5. Discussion

Our findings showed a significant difference between the experimental and control groups in scores of reaction time differences to emotional effects. The results of this study were consistent with those of some previous ones (9, 22-28); however, our findings revealed more subtle differences. We found that attention control training with the aid of computer leads to the reduction of attentional bias to furious, pleased, and surprised emotional effects. Attentional bias to frightened, disgusted, and sad emotional effects does not cause a significant decrease.

There are several possible explanations for these findings. Fox et al. believed that people with social anxiety may increase their anxiety by showing more attentional bias towards threatening external stimuli. The relationship between attentional bias and social anxiety can be of cyclical nature, indicating that social anxiety is associated with a bias towards threatening signs and vice versa (29). Fuchs et al. reported that the capability of quick release of signs of threat can be employed as a positive factor in anxiety reactivity, while disability to effectively release attention from threatening stimuli plays a role in increasing and sustaining anxiety responses. Accordingly, training to promote the ability to release attention has been successful in ABM (30, 31).

Table 2. ANCOVA to Compare the Experimental and Control Groups in Response to Emotional Effects

Source	Sum of Square	df	Mean Square	F	P Value	Eta Square
Pre EF	268.66	1	268.66	0.76	0.39	-
Group	11234.48	1	11234.48	32.14	0.001	0.59
Error	7677.04	22	349.45	-	-	-
Pre FE	4763.79	1	4763.79	2.22	0.15	-
Group	25022.5	1	25022.5	11.68	0.002	0.34
Error	47105.4	22	2141.15	-	-	-
Pre SE	3468.47	1	3468.47	0.42	0.52	-
Group	55591.48	1	55591.48	6.83	0.01	0.23
Error	178955.96	22	8134.36	-	-	-
Pre DE	1129.02	1	1129.02	0.54	0.46	-
Group	8206.67	1	8206.67	3.95	0.06	-
Error	45687.07	22	2076.68	-	-	-
Pre HE	17226.36	1	17226.36	2.67	0.03	0.10
Group	34670.21	1	34670.21	0.37	0.03	0.19
Error	141850.24	22	6447.73	-	-	-
Pre AE	28.93	1	28.93	0.01	0.91	-
Group	1694.69	1	1694.69	0.69	0.41	-
Error	54030.32	22	2455.92	-	-	-
Pre SE	740.56	1	740.56	0.49	0.49	-
Group	3281.68	1	3281.68	2.17	0.15	-
Error	33163.69	22	1507.44	-	-	-

Abbreviations: AE, afraid effects; DE, disgusting effects; EF, emotional effects, FE, furious effects; HE, happy effects, SE, sad effects; SE, surprised effects.

Evidence suggests that when emotional effects are combined with neutral stimuli, the ability of releasing attention from threatening emotional effects toward neutral effects can be effective in treating this disorder (23-25, 27). Several explanations have been proposed for quick response to emotional stimuli. Ohman's face-tracking pattern may be also interpreted in such a way that attentional bias with a focus on unconscious processing of threat in people follows an evolutionary adaptation process. When information from the face-tracking system passes, it enters a meaningful assessment system, then this threatening piece of information is consciously understood and causes a person to be excited. High arousal increases the sensitivity of meaningful assessments (32); therefore, the person immediately responds to emotional effects. Probably according to Ohman's view, attention control training leads to decreased sensitivity of meaningful assessments compared to emotional effects. On the basis of Beck and Clark's framework (33), it can be stated that attention control training would cause information processing system not to allocate threatening meanings to harmless stimuli.

In the present study, it was assumed that by changing certain components of therapy, the effectiveness of attention bias would increase. Hence, the target stimulus (emotional stimuli) was changed in the final blocks. Our findings revealed that the effect of this assigned method was 0.59. Although the sizes of these effects are related to the overall effect of the intervention, a subtler finding of this study is related to the fact that various emotional stimuli have different impacts. For example, emotional effects of anger, surprise, and happiness have different levels of impact. The effect size of this intervention on emotional effects of anger, surprise, and happiness was 0.34, 0.23, and 0.19, respectively. This finding signifies that various emotional effects are differently affected by attentional bias.

5.1. Conclusions

ABM has a limited range. In some effects such as frightened, disgusted, and sad ones, attention training intervention did not have any effects on attentional bias. With changing the components of intervention (for example, the rate of presentation of the target stimulus), the effectiveness of attentional bias would increase. Emotional effects have different effects on attentional bias.

5.2. Limitation

The limitation of this study was related to the sample size and the subjects' deduction. Since five participants were excluded from the experimental group, caution should be exercised in interpreting the findings. Another limitation was that follow-up data were not col-

lected. Therefore, short- and long-term effects of the intervention cannot be judged. Another limitation was that this study was conducted only on Semnan University students; thus, the generalization of the results should be handled with care. It is recommended that to use larger samples to evaluate the effect of the treatment intervention more closely to actual values. It is also recommended that some evidence on the effects of short-, medium-, and long-term trial interventions be collected in order to be able to make inferences about the sustainability of leanings. Furthermore, it is suggested that this method be used as a selection method to treat patients with anxiety disorder in counseling clinics.

Footnotes

Authors' Contribution: Siavash Talepasand contributed to study planning, conception, and design, as well as analysis of data. Somayeh Haddadi wrote the first draft of the manuscript. Isaac Rahimian gave us comments.

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