




# Software-based Attention Bias Modification Intervention for Adult EFL Learners' Foreign Language Anxiety

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**Abstract**—Foreign language anxiety has long been considered detrimental to second language acquisition to the extent that some teaching methods were based on anxiety reduction in language classrooms. Cognitive bias modification is an almost new procedure for reducing anxiety and depression. The current mixed methods study aimed at investigating the effect of software-based attentional CBM on adult Iranian EFL learners' language anxiety. Participants of the study were 79 English language learners ( $M = 23.73$ ,  $SD = 1.42$ ), selected based on convenience sampling from three foreign language institutes in Tehran. The distribution of gender was almost equal. Data were collected through Foreign Language Classroom Anxiety Scale before and after applying the software-based attentional bias modification intervention. Furthermore, semi-structured interviews were run to explore how this treatment would affect the anxiety level of language learners. Analysis of Covariance results revealed that the software-based attentional bias modification significantly reduced foreign language anxiety of the learners. Furthermore, analysis of the qualitative data showed that attentional bias modification mainly affects the communication apprehension and test anxiety components of foreign language anxiety.

**Keywords:** Software-based intervention, Anxiety, Attention bias modification (ABM), Cognitive bias modification (CBM), Foreign language anxiety (FLA)

## 1. INTRODUCTION

As one the mostly studied emotion-related concepts in second language acquisition (SLA) research, 'foreign language learning anxiety' (FLLA) refers to "a distinct complex of self-perceptions, beliefs, feelings and behaviours related to classroom language learning arising from the uniqueness of the language learning process" (Horwitz et al., 1986, p. 128). When second or foreign language learners are expected to use their developing languages, they experience feelings of fear and apprehension (Gardner & MacIntyre, 1993), and these feelings are present in a variety of classroom activities including listening and speaking as well as testing situations (Horwitz et al., 1986). FLLA is one of the most important affective factors which correlates negatively with students' performance in the classroom (Liu & Huang, 2011; Olivares-Cuhat, 2010), and previous research in this area indicated that speaking-oriented activities are associated with higher levels of anxiety among language learners (Young, 1990). Consequently, the ambiguity-provoking nature of Foreign Language Learning (FLL) leads learners to establish an interlanguage from the zero, which is inherently an anxiety-inducing process (Dewaele & Shan Ip, 2013). MacIntyre and Gregersen (2012) maintain that FLLA tends to interfere with learners' cognitive functioning at all stages of information processing (i.e., input, processing, and the output stage), leading to weaker memory, high levels of frustration, less confidence, inefficient group work, and lower language achievement. FLLA has been differentiated into

facilitating and debilitating types, since experiencing this emotion either improves or impairs the performance of language learners (Alpert & Haber, 1960). Scovel (1978) believes that the facilitating anxiety gears the learners emotionally and motivates them to face with new learning tasks, while the debilitating anxiety motivates them to avoid new tasks. FLLA is also related to some psychological factors including shyness, self-perception, competitiveness, and social anxiety (He, 2018).

Over the last decades, various aspects of FLLA has been investigated in different contexts and learning situations, and a substantial body of published literature in this area suggests that anxiety can negatively influence the experience of learning a new language in numerous ways (Alrabai, 2015; Gardner & MacIntyre, 1993; Gregersen & Horwitz, 2002; Horwitz et al., 1986; Horwitz & Young, 1991; D. S. Kondo & Ying-Ling, 2004; Ohata, 2005; Spielberger, 1983; Stroud & Wee, 2006; Yan & Horwitz, 2008). Horwitz and Young (1991) claimed that the question of how anxiety impedes language learning is still unresolved. However, it has been argued in the literature that FLLA “harms learners performance in many ways, both indirectly through worry and self-doubt, and directly by reducing class participation and creating overt avoidance of the language” (Xiang, 2004, p. 116). According to Krashen (1988, 1995), anxiety inhibits learners’ ability to process language input and as a result short-circuits the process of language acquisition, and MacIntyre and Gardner (1989) posit that anxious people engage themselves in self-directed derogatory cognition, rather than focusing on the task at hand. A number of studies also indicated that FLLA can be the cause of some problems in language learning process (MacIntyre & Gardner, 1991a, 1991b, 1991c, 1994a, 1994b), and reducing anxiety seems to increase learner motivation (Horwitz et al., 1986; Young, 1990).

The serious repercussions of FLLA necessitate learners to mitigate the impacts of this negative emotion through adopting intervention-based procedures. In this regard, a variety of strategies such as Lazarus’s (2000) coping strategies as well as Gregersen and MacIntyre (2014) and Helgesen’s (2016) positive psychology-oriented techniques (e.g., meditation and relaxation, exercise) have been proposed. However, such strategies may target merely the affective dimension of anxiety and overlook the cognitive component, which is tightly associated with Cognitive Biases (CBs). According to Bar-Haim et al. (2007), there is a marked tendency for anxious individuals to experience CBs while information is being processed in their short-term memory. In other words, due to its sensitivity to threat-relevant stimuli, the anxious individual’s attentional system tends to focus specifically on threatening information throughout different stages of processing (Bar-Haim et al., 2007). Moreover, during the past three decades, psychologists have relied on cognitive dimensions of anxiety, which contributes to better understanding of anxiety (Grafton & MacLeod, 2014). In this regard, the application of Attentional Bias Modification (ABM) (Beard, 2011) might be a potentially effective strategy for reducing the anxiety among language learners. In light of these considerations, the present study aimed to investigate the impacts of software-based ABM intervention among Iranian language learners.

## 2.1 Literature Review

### 2.1.1 Foreign Language Anxiety (FLA)

The construct of anxiety is generally defined as “experiencing subjective overwhelming feelings such as tension, apprehension, nervousness, and worry that are related to simulation of the autonomic nervous system” (Spielberger, 1983, p. 15). More specifically, Horwitz et al. (1986, p. 128) defined FLA as “a distinct complex of self-

perceptions, beliefs, feelings, and behaviors related to classroom language learning arising from the uniqueness of the language learning process”. The three dimensions of anxiety are trait anxiety, state anxiety, and situation-specific anxiety (MacIntyre, 1999). Lababidi (2015) holds that trait anxiety is considered a relatively stable personality characteristic in a variety of situations in general. However, state anxiety, as a temporary and moment to moment response to a specific stimulus, only relates to specific situations. Situation-specific anxiety refers to a personal tendency to become anxious in a particular situation or a specific context (Lababidi, 2015).

Language anxiety can be further classified under the third dimension (i.e., situation-specific anxiety). Studies have found a negative effect of anxiety on the L2 acquisition process (e.g., Gregersen, 2003; Horwitz et al., 1986). As pointed out by Horwitz et al. (1986, p. 127), L2 anxiety consists of “1) communication apprehension; 2) test anxiety; and 3) fear of negative evaluation”.

Communication apprehension highlights interpersonal interactions, and it is defined as “a type of shyness characterized by fear of or anxiety about communicating with people” (Horwitz et al., 1986, p. 127). Test anxiety refers to “a type of performance anxiety stemming from a fear of failure” (Horwitz et al., 1986, p. 127). Furthermore, Zeidner (1998) defined test anxiety as “the physiological arousal, tension, and worry that occurs before or during test situations” (as cited in Shao et al., 2019, p. 13).

The third component of FLA is fear of negative evaluation. It is defined by Horwitz et al. (1986) as “apprehension about others’ evaluations, avoidance of evaluative situations, and the expectation that others would evaluate oneself negatively” (p. 128).

### 2.1.2 Cognitive Effects of FLA on Language Processing

Zheng and Cheng (2018) reported that worry and emotionality are two main sub-categories of anxiety. Worry demonstrates the cognitive dimension of anxiety (e.g., excessive worry over evaluation and comparing personal performance to others). However, the emotionality dimension is identified by negative feelings aroused by physiological functioning (e.g., increased heart rate, feelings of panic and dizzy, etc.). They also reported that anxious learners are more likely to experience task-irrelevant cognitive processing than others with no anxiety. As a result, working memory capacity may be restricted due to the demand of task-irrelevant processing activities. In fact, anxiety interferes with the cognition threshold in learning, which may result in distraction among anxious learners (Zheng & Cheng, 2018). In other words, the speed and quality of cognitive functions during task performance seem to be drastically affected by anxiety.

Additionally, according to Tobias’s (1986) model of cognitive effects of anxiety on learning, anxiety arousal during the input stage may interfere with the learner’s first exposure to a stimulus, which can lead to distraction during stimuli encoding. Thus, repeated exposure to the task might be required. Likewise, anxiety can hinder the comprehension of incoming messages and disrupt learning at the processing or meaning-making stage. The consequences of anxiety arousal at the output or production stage may include failing to retrieve vocabulary effectively, using grammar rules inappropriately, or a total failure at producing the expected response (Khan & Zafar, 2010).

### 2.1.3 FLA in the Iranian Context

Language learning in Iranian context is infused with anxiety-provoking situations. Despite the influence of globalization and technological advancements, EFL learners

are hardly exposed to English outside the classroom. Furthermore, English is one of the compulsory courses in Iranian mainstream education and students will study English for at least 7 years at school, along with nearly 6 credits of English at university. Thus, it is deemed essential for students to overcome the constant challenge of learning English as a foreign language. Additionally, a dramatic rise in the rate of emigration has forced Iranian students to attend extra-curricular English courses in different language institutes, which has presented more challenges to them.

The pedagogical challenges coupled with the socio-economic crises in the Iranian context have made EFL learners increasingly susceptible to FLA. On the other hand, the multi-faceted nature of FLA has constituted impediments to intervention-oriented studies with the aim of reducing FLA. Thus, despite a good number of FLA studies in the Iranian context (e.g., Khodadady & Khajavy, 2013; Mahmoodzadeh, 2013), little research has been conducted with regards to the FLA treatment.

#### 2.1.4 Anxiety and Attentional Biases (ABs)

Anxiety is theoretically associated with biases while individuals are dealing with information which may pose threats to them (Bar-Haim et al., 2007). Cognitive psychologists posit that when people are exposed to a threat-related stimulus, their appraisal of the capacity to overcome that situation can provoke different levels of anxiety (Pappamihiel, 2002). A good number of scholars (e.g., Bar-Haim et al., 2007; Fox et al., 2002; Mathews & Mackintosh, 1998, etc.) believe that there is a marked tendency for anxious individuals to experience CBs while information is being processed in their short-term memory. In other words, due to its sensitivity to threat-relevant stimuli, the anxious individual's attentional system tends to focus specifically on threatening information throughout different stages of processing (Bar-Haim et al., 2007).

Hertel and Mathews (2011, p. 522) posit that CBs involve “interpretation biases, memory biases, and attentional biases”. The emergence of negative interpretations as a result of anxiety is related to the learners' interpretation biases. ABs emerges when anxious people show a tendency to attend to threatening clues and indicators (Bar-Haim et al., 2007). Finally, memory biases deal with the fact that anxious people can be biased to recall the negative issues more than positive ones (Mathews & MacLeod, 2005).

In the same vein, Mogg and Bradley (2018) have defined AB as “the preferential tendency to allocate attention towards (or away from) stimuli which are motivationally/emotionally salient for the individual” (p. 226). The components of ABs and their underlying mechanisms have been best depicted in Cisler and Koster's (2010) integrative review. They also provided an elaborate account of different models of ABs over the past 20 years mainly focusing on individual differences in trait anxiety.

A wealth of theoretical models concerning ABs towards threat in anxiety, have been proposed by different scholars—for example, Bar-Haim et al.'s (2007) multidimensional model of ABs; Eysenck et al.'s (2007) attentional control theory; Mogg and Bradley's (2018) cognitive-motivational model, to mention but a few (see Cisler & Koster, 2010; Mogg & Bradley, 2018 for more details).

As reported by Cisler and Koster (2010), attentional control, emotion regulation strategy/goals, and neural mechanisms are identified as three mediating mechanisms underlying ABs. As an individual difference variable, attentional control is concerned with individuals' ability to regulate their attentional allocation, thus modulating difficulty in disengagement from threat. This top-down regulatory ability will prevent the bottom-up impact of emotional distracters (Eysenck et al., 2007).

Emotion regulation refers to the processes of influencing individuals' emotions, the time and the way they may experience and express these emotions (Gross, 2015). As emphasized by Gross (2015), purposeful attentional allocation towards a neutral or positive stimulus (i.e., distracter) while being exposed to unpleasant stimuli can be one of the strategies of emotion regulation. Hence, these mechanisms attempt to modulate the attentional avoidance component of ABs. Finally, neural mechanisms refer to the enhanced amygdala activity involved in automatic vigilance/facilitated attention for threat (Myers & Davis, 2007). Further explanations on different models of ABs, mechanisms and their conceptualization at varying stages of information processing can be found in Cisler and Koster (2010).

### 2.1.5 Cognitive Bias Modification (CBM)

Firmly established in cognitive psychology, CBM focuses on modification processing of biases that are likely to unfold unconsciously, though it can be identified through cognitive experimental assessment tasks (Grafton & MacLeod, 2014). In fact, CBM is aimed at changing such processing selectivity by providing the individual with extended exposure to task variants devised to implicitly encourage change in these biases (Avirbach et al., 2018).

According to Cristea et al. (2015), CBM entails two major types of interventions namely: a) attention bias modification (ABM) or CBM-A, and b) interpretative bias modification (CBM-I). ABM is defined as “teaching participants to avoid the negative, threat stimuli (usually pictures or words) by directing their attention, without their knowledge, to neutral or positive stimuli (avoid threat)” (Cristea et al., 2015, p. 7).

Research conducted on CBM-A training programs uncovers a variety of experimental tasks for AB modification purposes—e.g., dot probe, visual search, modified stroop, spatial cueing, flanker (Cisler & Koster, 2010). De Voogd et al. (2014) adopted a visual search ABM as a training paradigm to examine the effects of ABM on sixteen adolescents' ABs and their social phobia. They used a series of 4\*4 grid of emotional faces in which the participants had to identify one positive face among a group of fifteen negative faces. The results indicated a significant decrease in their ABs and self-reported social anxiety. In another study, Cai et al. (2018) used a 5-day modified dot probe task as ABM training for twenty-nine participants. The results of their study revealed that anxiety vulnerability with attention to threats was significantly decreased in the trained group.

In the same vein, Mogg and Bradley (2018, p. 233) have reported on some alternative methods of CBM-A training—i.e., “gamified ABM, adaptive ABM, card game-based person–identity matching, attention feedback awareness and control training (A-FACT), gaze-contingent music-reward therapy, enhanced positive search training”. All of these tasks are structured based on the premise that “if threatening and neutral stimuli occur together, the attention of an anxious individual will likely be biased towards the threat” (Cisler & Koster, 2010, p. 204).

However, an in-depth overview of the studies on CBM (e.g., Avirbach et al., 2018; Cox et al., 2016) and on FLA (e.g., Dewaele, 2017; Zhang, 2019) reveals that, to date, no research has attempted to explore CBM in relation to EFL learners' FLA. Therefore, concerning the detrimental effects of FLA on language learning and to fill the gap in the currently available literature, the following research questions were raised in line with the objectives of the study:

- 1) Does software-based ABM affect adult EFL learners' self-reported foreign language anxiety?

- 2) What are the perceptions of adult EFL learners towards the contributions of software-based ABM in reducing their self-reported foreign language anxiety?

## 2. METHODS

The study utilized an explanatory sequential embedded design, which is conducted in two phases: In phase one the quantitative data were collected, analyzed and then interpreted. Phase two was concerned with the qualitative data collection, analysis and interpretation (Creswell & Plano Clark, 2011).

### 2.1 Participants

The participants of the study were 79 intermediate EFL learners who were studying English at three foreign language institutes in Tehran. They were both male ( $n = 39$ ) and female ( $n = 40$ ) language learners within the age range of 22 to 27 ( $M = 23.73$ ,  $SD = 1.42$ ). Table 1 shows the distribution of the participants in quantitative and qualitative phases of the study. As for the ethical considerations, all the participants signed a consent form prior to the research, and they were assured of their anonymity in the course of the study.

**Table 1.** Distribution of the Participants in Quantitative and Qualitative Phases of the Study

	Exerimental Group		Control Group	
	Gender	Age	Gender	Age
Quan phase	m=19; f=19	22-27	m=20; f=21	22-27
Qual phase	m=5; f=5	22-27		

### 2.2 Research Instruments

#### 2.2.1 Language Proficiency Test

To homogenize the participants, a B1 Preliminary test was administered to the participants. As an intermediate level exam (i.e., B1 in CEFR), this test assesses the ability to communicate using English for everyday purposes. It is composed of four sections including reading, writing, listening and speaking. The reading and writing sections consist of 60 points in total (35 for reading and 25 for writing section respectively). The listening section has 25 points and finally the speaking section has 15 points which amount to 100 altogether.

To confirm the reliability of the test for the purpose of the present study, the reading and listening sections were piloted to 30 participants having similar characteristics to the main participants of the study and Cronbach's Alpha was calculated to be 0.85. As for the writing and speaking sections, inter-rater reliability was calculated (i.e., 0.76 and 0.82 for the speaking and writing sections, respectively).

#### 2.2.2 Foreign Language Classroom Anxiety Scale (FLCAS)

In order to measure student anxiety, Foreign Language Classroom Anxiety Scale (FLCAS) developed by Horwitz et al. (1986) was employed. The scale contains 33 items and measures three subcomponents of FLA (i.e., communication apprehension, test anxiety and fear of negative evaluation) on a five-point Likert scale ranging from strongly

agree to strongly disagree. The respondent's overall score ranges from 33 to 165, in which the higher number would be an indication of higher level of anxiety.

In the current study, the questionnaire was translated into Persian. Two MA holders of translation employed the back translation technique for the validation purposes. As the second step of validity check, the questionnaire was also piloted to 35 students and the KMO Measure of Sampling Adequacy was 0.69, above the recommended value of 0.60, and also Bartlett's Test of Sphericity was found statistically significant ( $X^2(595) = 2624.78, P < 0.05$ ). Additionally, the reliability of the Persian version of the questionnaire was estimated using internal consistency measure of Cronbach's Alpha ( $r = 0.83$ ).

### 2.2.3 Test your Attention Bias (TAB)

The software utilized for the treatment phase of the study was Test your Attention Bias (TAB). It was designed in collaboration with an experienced computer programmer with five years of expertise in developing e-learning materials and online games. This software was created by 'Articulate Storyline 2', which is an e-learning authoring tool with a variety of functions.

In this study, TAB includes a series of 4\*4 grids of 72 emotional faces, drawn from Egger et al.'s (2011) stimuli set. These 72 facial expressions—positive (happy),  $N=36$ , and negative faces (angry, fearful, and sad),  $N=36$ —were randomly selected from the National Institute of Mental Health (NIMH) Child Emotional Faces Picture Set (NIMH-ChEFS), including high resolution emotional faces of both male and female adolescent actors between 10-18 years old, with equal gender distribution (see Figure 1).

The 4\*4 grids were presented in two stages, the first of which was run for preparing participants and familiarizing them with the main task. In fact, in the first stage and before the treatment phase, TAB was piloted to 30 learners with almost similar characteristics, achieving a reliability index of .78, which was an acceptable index.

Each stage consisted of 36 trials. In each trial, a 4\*4 grid of 15 negative and 1 positive faces appeared on the computer screen. The probability for the appearance of each positive face was  $1/36$  and the other 15 negative faces was  $15/36$ . Participants must click on the positive face as fast as possible. After each click, another grid of 16 faces would appear. The total number of randomly selected positive and negative faces in each stage was 36 and  $36*15$  respectively. At the end of each stage, the total score was reported in order to examine the progress over the treatment period.



Figure 1 Screenshot of the 4\*4 grid in TAB

#### 2.2.4 Semi-Structured Interviews

In order to seek the learners' perceptions towards the contributions of CBM in reducing their anxiety, semi-structured interviews were held with 10 EFL learners. These participants were selected from the experimental group based on their high score on the pre-test, and the most significant difference between their pre- and post-test results. The students were mainly requested to specify their opinions about the AB as a source of anxiety and the effectiveness of attentional CBM on various aspects of anxiety indicated in FLCAS, i.e., communication apprehension, fear of negative evaluation, and test anxiety. The questions of the interview had been also expert reviewed by two experts (both holding PhDs in Teaching English as a Foreign Language) for the credibility purposes. In this study, the interviews were conducted in Persian language and audio-recorded by the researchers. Each interview lasted approximately 10-15 minutes.

### 2.3 Procedures

#### 2.3.1 Quantitative Phase

For the quantitative module, participants were selected conveniently. After homogenizing, 79 learners were selected as the target participants of the study. They were randomly assigned into an experimental ( $n= 38$ ) and a control group ( $n=41$ ). In both groups, the learners completed the FLCAS as a pre-test. In the experimental group, the ABM training software focused on the task response procedure in line with De Voogd et al.'s (2014) training version of the Emotional Visual Search Task (EVST). The treatment was conducted three times a week for a period of one month in total (for a detailed explanation, see the instruments section: TAB). After the treatment period, we administered the FLCAS to the learners in both groups as a post-test in order to measure the possible changes in their self-reported anxiety level.

#### 2.3.2 Qualitative Phase

For the qualitative phase, we extracted an embedded sample from the quantitative sample. Utilizing a purposive sampling strategy, we selected the participants who, despite showing high levels of anxiety in the pre-test, achieved significant progress after receiving the treatment. They were selected based on their performance on the post-test. To this aim, out of the 38 participants in the experimental group, 10 (5 males and 5 females) EFL learners, whose informed consent was obtained, were selected and interviewed in the qualitative phase of the study.

These 10 learners were invited to participate in the one-on-one, face-to-face interviews for giving their opinions about the effectiveness of software-based ABM. Each interview lasted 10 to 15 minutes, during which the learners were asked to express their opinions about the AB as a source of anxiety and the effectiveness of the ABM program in terms of its effect on various components of FLA like Communication Apprehension, Fear of Negative Evaluation, and Test Anxiety.

### 2.4 Data Analysis

To do analysis on the obtained data, statisticians (e.g., Tabachnick, & Fidell, 2007) suggest data screening be performed first. This is needed for examining the normality of scores distribution to decide about an appropriate method of analysis. Thus, data screening was carried out to see whether there were any outliers. There were four cases of outliers in the pre-test scores (cases 12, 1, 40, and 60) and two cases of outliers in the post-test scores (cases 40 and 60). The four cases were removed from the study. Thus,



there remained 79 participants in total in the main analysis. It should be noted that cases 1, 12 and 40 were from the participants in the experimental group and case 60 was from the participants in the control group. Therefore, in the final analysis, there were 38 participants in the experimental group and 41 participants in the control group.

We used a one-way ANCOVA to analyze the quantitative data. ANCOVA has a number of assumptions including outliers, normality, reliability of co-variates, multicollinearity, linearity, homogeneity of regression, and homogeneity of variance. The outliers were discarded in the current study. Thus, the first assumption was met. As for the second assumption, Kolmogorov Smirnov test (see Table 2) indicated that all the pre-test and post-test scores in the experimental and control groups were normally distributed ( $p > .05$ ).

**Table 2.** One-Sample Kolmogorov-Smirnov Test Results

		Anxiety Pre Experimental	Anxiety Pre Control	Anxiety Post Experimental	Anxiety Post Control
Normal Parameters <sup>a,b</sup>	N	38	41	38	41
	Mean	72.9474	72.4390	56.2895	72.0244
	Std. Deviation	3.57882	2.71154	7.03623	2.44426
Most Extreme Differences	Absolute	.132	.167	.201	.114
	Positive	.076	.093	.082	.114
	Negative	-.132	-.167	-.201	-.106
Test Statistic		.132	.167	.201	.114
Asymp. Sig. (2-tailed)		.190	.125	.210	.200

The third assumption (i.e., reliability of co-variates), was assured via selecting a “well-validated questionnaire” (Pallant, 2010, p. 299), which is the FLCAS in this study. Multicollinearity assumption was already met because there was only one covariate. As for the linearity, scatterplot of the variables was checked.

The scatterplot of variables showed that the relationship between the dependent variable (anxiety post-test) and covariate (anxiety pre-test) was in the form of straight diagonal line which indicates that the relationships are linear. Thus, the assumption of linearity was met. Concerning the next assumption i.e., homogeneity of regression, it was found that the slopes of relationship lines (regression lines) did not cross each other, revealing that the assumption of homogeneity of regression slopes was met. The last assumption was the homogeneity of variances that was checked using the Levene’s test of variances (see Table 3).

**Table 3.** Levene’s Test of Equality of Error Variances

F	df1	df2	Sig.
50.834	1	77	.120

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Anxiety Pre + Groups

Based on the results of the Levene’s test, variances in the dependent and covariate variables were equal, hence the assumption of homogeneity of variances was also met ( $F = 50.83, P > .05$ ). After making sure that all of the assumptions were successfully met, the main ANCOVA output was examined.

### 2.4.1 The ANCOVA Results

Prior to running ANCOVA, descriptive statistics were computed for the data sets. The respective results are presented in Table 4.

**Table 4.** Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Anxiety Pre Experimental	38	14.00	65.00	79.00	72.9474	.58056	3.57882
Anxiety Pre Control	41	12.00	66.00	78.00	72.4390	.42347	2.71154
Anxiety Post Experimental	38	32.00	39.00	71.00	56.2895	1.14143	7.03623
Anxiety Post Control	41	12.00	65.00	77.00	72.0244	.38173	2.44426
Valid N (listwise)	37						

Descriptive statistics showed that the experimental group made more progress in terms of anxiety reduction. The experimental group’s mean scores on the pre- and post-tests were 72.94 (SD = 3.57) and 56.28 (SD = 7.03), respectively. However, in the control group, learners scored 72.43 (SD = 2.71) on the pre-test and 72.04 (SD = 2.44) on the post-test. To accurately estimate how software-based ABM affected the anxiety of the learners, we conducted an ANCOVA on the pre-test and post-test scores of the two groups, the results of which are summarized in Table 5.

**Table 5.** Tests of Between-Subjects Effects (ANCOVA)

Dependent Variable: Anxiety Post						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4883.019 <sup>a</sup>	2	2441.509	89.615	.000	.702
Intercept	619.987	1	619.987	22.756	.000	.230
Anxiety Pre	.215	1	.215	.008	.929	.000
Groups	4845.369	1	4845.369	177.848	.000	.701
Error	2070.576	76	27.244			
Total	335162.000	79				
Corrected Total	6953.595	78				

a. R Squared = .702 (Adjusted R Squared = .694)

The ANCOVA results revealed that there was a statistically significant difference between the experimental and control groups in terms of anxiety level ( $F = 177.84, p = .00 < 0.5$ ). This indicates that software-based ABM used by the participants in the experimental group significantly reduced the anxiety level of foreign language learners. As shown in Table 5, the effect size was large (Eta Squared = 0.70). As reported by Gray and Kinnear (2012), the criteria for the effect size of partial eta squared may vary in the following range: “below .01 is weak, above .06 is moderate, and higher than .14 is large (strong)” (p. 285). Thus, the effect size of .70 is considered large.

### 3. RESULTS

The data derived from the semi-structured interviews were analysed thematically to understand how congruent or incongruent learners’ opinions about the effect of software-based ABM on anxiety were as compared to the quantitative results. To this aim, thematic analysis was applied as “a method for identifying, analyzing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79). Initially, the data were transcribed and then thematized by the researchers individually. Using a code-recode strategy, the extracted themes were discussed further in order to achieve a more in-depth understanding (Ary et al., 2014).

A number of key themes emerged from the process of analysis, based on which the learners’ opinions about the effectiveness of software-based ABM on various components of FLA were identified and lastly tabulated. The themes, pertaining to the sources of anxiety, extracted from the interviews included: a) instructor-related factors; b) error-correction factors; c) exam-related factors; d) fear of classmates’ reactions; and e) fear of making class presentations; f) fear of not being understood during communication; g) self-evaluation factors. These themes could be classified under three main categories of 1) Communication Apprehension or CA (themes e, f); 2) Fear of Negative Evaluation or FNE (themes a, b, d, g); and 3) Test Anxiety or TA (theme c), which is also supported by the relevant literature on FLA (e.g., Dewaele, 2017; Horwitz et al. 1986; Lababidi, 2015; Zheng & Cheng, 2018). Moreover, we extracted some themes which pertain to the participants’ reduction of ABs, including, ABMa) deviation of attention from anxiety-related stimuli; ABMb) attending more to less threatening stimuli; and ABMc) inhibition of negative attention and ABMd) facilitation of positive attention toward stimuli. These themes have been discussed more or less in the literature related to CBs and ABM programs (e.g., Bar-Haim et al., 2007; Beard, 2011; Mogg & Bradley, 2016). Table 6 shows the FLA- and AB-related themes extracted in the interview phase. The sample excerpts in the table, which are the translated versions of learners’ statements, unveil some of these themes emerged in the process of thematic analysis.

**Table 6.** Extracted Themes (i.e., FLA-related and Software-based ABM-related) in the Interview Phase

FLA-related Themes	Frequency(#) and Percent (%) of Students’ Responses per Theme	Sample Excerpt
a) instructor-related factors (FNE)	7 (70%)	S4 “Teachers’ reaction and mood have always affected my anxiety level. I remember, during the class time, I was expecting a negative comment from the teachers even if it would never happen.”
b) error-correction factors (FNE)	8 (80%)	S5 “It happened to me a lot when I made grammar mistakes, and the teacher was correcting me, I didn’t understand what error he referred to. This really made me both frustrated and anxious.”
c) exam-related factors (TA)	7 (70%)	S8 “I had a big fear of final examinations at the end of the term... When I faced a difficult question, I couldn’t concentrate on the rest of questions, even the easiest ones!”
d) fear of classmates’ reactions (FNE)	8 (80%)	S1 “I think that I would perform badly, even if I practice. I am too much concerned about my classmates’ reactions.”
e) fear of making class presentations (CA)	8 (80%)	S2 “I always felt extremely anxious when I was supposed to make a presentation in front of the teacher and my classmates. I only paid attention to their negative reflection and feedback.”
f) fear of not being understood during communication (CA)	8 (80%)	S8 “I used to think if I started to speak in the class, my classmates wouldn’t understand what I exactly meant. Even if I was prepared, I felt so nervous.”
g) self-evaluation factors (FNE)	6 (60%)	S9 “I never felt I was prepared enough for the classroom tasks, even if I had studied before.”

AB-Related Themes		
ABMa) deviation of attention from anxiety-related stimuli	8 (80%)	S3 “I used to be very sensitive to my teacher’s reactions and always checked her reactions to my speaking. After the software-based ABM intervention, I think I got less concerned about how teachers think of my performance... I feel this treatment has gradually deviated my attention from negative feedback”.
ABMb) attending more to less threatening stimuli	7 (70%)	S8 “Whenever, I looked at English texts, specially, in the exams, I first noticed the difficult words, unknown idioms etc... software-based ABM was an exercise for me to focus first on the things that I know. This made me feel more confident in my exams.”
ABMc) inhibition of negative attention	8 (80%)	S10 “I used to be oversensitive about my classmates’ feedback. During software-based ABM, I learned how to deliberately avoid attending to others’ negative reflections in the classroom”.
ABMd) facilitation of positive attention toward stimuli	6 (60%)	S7 “While facing both negative and positive faces on the screen, I tried to direct my attention to smiling faces only. It was hard at first, but little by little I managed to do so... After the training sessions, I think I got less anxious when entering the language class”.

As can be seen in Table 6, among FLA-related themes, 70% of the interviewees referred to instructor-related factors, 80% to error-correction factors, 70% to exam-related factors, 80% to fear of classmates’ reactions, 80% to fear of making class presentations, 80% to fear of not being understood during communication, and 60% of them referred to self-evaluation factors. Concerning software-based ABM-related themes, 80% pointed to deviation of attention from anxiety-related stimuli, 70% to attending more to less threatening stimuli, 80% to inhibition of negative attention, and 60% of the interviewees referred to facilitation of positive attention toward stimuli. Therefore, based on the interview results, software-based ABM intervention made positive contributions to decreasing learners’ attention to threat-driven aspects of foreign language learning.

#### 4. DISCUSSION

Table 7 displays the results of the interviews based on the effects of software-based ABM on each interviewee’s FLA components and their ABs. As shown in the table, S1, S5 and S6 have referred to all three components of FLA (i.e., CA, FNE, and TA). They also pointed to all four themes concerning the software-based ABM intervention. S2 and S7 referred to 85.71% of the FLA-related themes, both of whom pointing to all three components of FLA. Both interviewees referred to 50% of the AB-related themes, with S2 pointing to ABMc, and ABMd, and S7 pointing to ABMa and ABMc. S3, S4, and S10 referred to 71.42% of the FLA-related themes, with S3 and S4 pointing to CA and FNE, and S10 pointing to all three components of FLA. All three interviewees referred to 75% of the AB-related themes. Both ABMb and ABMc were pointed by S3 and S4. However, ABMa was pointed by S3 and S10, and ABMd by S4 and S10. Finally, the least percent of FLA-related themes (28.57%) was reported by S8 and S9, with S8 pointing to CA and TA, and S9 pointing to CA and FNE components of FLA. They both referred to only 50% of the AB-related themes, with S8 pointing to ABMa, ABMc, and S9 pointing to ABMa and ABMb. Table 7 also shows that S1, S5, and S6 had the highest difference between their pre- and post-test scores (i.e., 25, 24 and 18 respectively), whereas, S8 and S9 had the lowest difference between their pre- and post-tests (i.e., 10 and 9 respectively). Overall, the results of integrating quantitative and qualitative data show that the sample extracted from the experimental group experienced degrees of relief in fear of negative evaluation, test anxiety, and communication apprehension components of FLA.

Numerous research found that when ABM was used, anxiety was reduced more. Eight studies specifically found that standard ABM training was more effective at lowering anxiety than other training methods. These studies all used laboratory or clinic settings to administer the training (Amir, Beard, Burns & Bomyea, 2009; Amir, Beard, Taylor, Klumpp, Elias, Burns & Chen, 2009; Bar-Haim Morag & Glickman, 2011; Eldar, Apter, Lotan, Edgar, Naim, Fox & Bar-Haim, 2012; Hazen, Vasey, & Schmidt, 2009; Kuckertz, Amir, Boffa, Warren, Rindt, Norman & McLay, 2014). These studies mostly employed pairs of threat-neutral phrases, disgust-neutral faces, angry-neutral faces, and negative-positive faces as stimuli for the visual-probe task for ABM training (one study also used the spatial-cuing task; Bar- Haim et al., 2011).

Another home-based study by Kuckertz, Gildebrant, Liliequist, Karlström, Våppling, Bodlund, Carlbring, (2014) found that anxiety reduction was greater when ABM training and fear-activation were combined (participants were asked to engage in an anxiety-provoking activity before each ABM training session); as opposed to ABM without fear-activation (data for the latter two conditions were from Carlbring, Apelstrand, Sehlin, Amir, Rousseau, Hofmann & Andersson, 2012). Although there was no exposure-only condition, the combined condition’s anxiety reduction may have been brought on by fear-activation alone (because frequent exposure to anxiety-inducing activities may lower anxiety) or by its combination with ABM.

**Table 7.** Results of the Interviews based on the Effects of Software-based ABM on Each Interviewee’s FLA Components and Their ABs

Interviewee	CA	FN E	TA	Difference between Pre- and post-test	Extracted themes based on FLA components	Frequency(## and percent (%) of FLA- related themes	Extracted themes based on ABs	Frequency(## ) and percent (%) of AB- related themes
S1	✓	✓	✓	25	Themes a, b, c, d, e, f, g	7 (100%)	ABMa, ABMb, ABMc, ABMd	4 (100%)
S2	✓	✓	✓	15	Themes a, b, c, d, e, g	6 (85.71%)	ABMc, ABMd	2 (50%)
S3	✓	✓		13	Themes a, b, d, e, f	5 (71.42%)	ABMa, ABMb, ABMc	3 (75%)
S4	✓	✓		12	Themes a, b, d, e, f	5 (71.42%)	ABMb, ABMc, ABMd	3 (75%)
S5	✓	✓	✓	24	Themes a, b, c, d, e, f, g	7 (100%)	ABMa, ABMb, ABMc, ABMd	4 (100%)
S6	✓	✓	✓	18	Themes a, b, c, d, e, f, g	7 (100%)	ABMa, ABMb, ABMc, ABMd	4 (100%)
S7	✓	✓	✓	15	Themes a, b, c, d, e, f	6 (85.71%)	ABMa, ABMc	2 (50%)
S8	✓		✓	10	Themes c, f	2 (28.57%)	ABMa, ABMc	2 (50%)
S9	✓	✓		9	Themes f, g	2 (28.57%)	ABMa, ABMb	2 (50%)
S10	✓	✓	✓	12	Themes b, c, d, e, g	5 (71.42%)	ABMa, ABMb, ABMd	3 (75%)

## 5. CONCLUSION

The results obtained from the quantitative phase indicated that software-based ABM can significantly reduce language learners’ anxiety in foreign language classrooms. This finding was further explored and confirmed by the thematic analysis of the interview data, revealing that learners had positive perceptions on the efficacy of software-based ABM in reducing their self-reported FLA and its three components (i.e., communication apprehension, fear of negative evaluation, and test anxiety).

These findings are in proportion to a growing current literature proposing that modifying CBs directly through various tasks can be advantageous for psychopathology in anxiety (Hakamata et al., 2010). As pointed out by Browning et al. (2012), reduction in anxiety level, as in the case of this study, seems to be the product of changes in the individuals' ABs.

In line with the previous studies (e.g. De Voogd et al., 2014; Mogg et al., 2017), the results of this study support the claim that ABM can help individuals experience certain positive changes through connecting psychological behaviours and disorders to cognitive processes and mechanisms (Schofield, 2015; Avirbach et al., 2018). Using the software-based ABM training, in which individuals are prompted to change their attentional patterns (Neurother, 2011), the present study attempted to reduce learners' automatic attention toward negative facial expressions (angry, fearful, and sad). In fact, studies have shown that anxious people automatically get attended to the negative signs, words, behaviors, faces etc., which may push them to show anxious behaviors (e.g., Bar-Haim et al., 2007; Grafton & MacLeod, 2014).

As for the qualitative findings, the results obtained from the interviews showed that learners were positively affected in terms of attentional orientation. For example, the thematic analysis of the interviews revealed that the participants were less concerned about the classmates' look, teachers' reactions, and challenges of the English language classroom after the software-based ABM treatment. In other words, before being treated with software-based ABM, they seemed to attend more to the negative stimuli in the language learning context.

In the same vein, several empirical studies (e.g., Mogg & Bradley, 2016; Hakamata et al., 2010) have provided empirical evidence for the positive effect of ABM on anxiety reduction, which is congruent with the findings of the present study. In fact, despite the limited number of participants, this study still seems to be another empirical indication of the positive impacts of software-based ABM on anxiety reduction.

Nevertheless, a number of studies have reported the inconsistencies in the results of ABM training sessions (Cristea et al., 2015; Mogg & Bradley, 2018). For Example, Mogg and Bradley (2018) referred to the variable effects of ABM threat-avoidance training on anxiety reduction, claiming that conventional ABM methods have offered small effect sizes and poor outcomes. The reasons might include deficient training procedures, different settings (home vs. laboratory), the effect of multiple cognitive processes on ABs and anxiety, and the tedious and repetitive nature of such tasks. In addition, there is little theoretical agreement as to what components ABs have, what mechanisms mediate these components, and during what stage of processing the mechanisms operate. The only consistent prediction across the ABs models is that a threat detection mechanism operates at the automatic stage of processing and underlies facilitated attention to threat. This general lack of agreement makes it difficult to understand why attention is biased towards threat in anxious individuals.

In response to the existing challenges, a cognitive-motivational framework has been proposed by Mogg and Bradley (2018) based on multiple cognitive functions in order to improve the conventional ABM and make it more engaging and effective through multicomponent ABM training. However, the combined up-to-date version of software-based ABM seems obviously more demanding and complex in practice and its implementation requires cognitive psychologists to distinguish between "salience-driven and goal-directed modes of processing and different cognitive functions such as evaluation, inhibition, switching, and orienting" (Mogg & Bradley, 2018, 228).

The distinctiveness of the present study might lie in the specific context (i.e., Iranian L2 context), in which English language students experienced software-based ABM as a treatment for lowering their FLA. Although software-based ABM had a significant impact on the students' FLA, due to the inconsistent results of software-based ABM intervention in the relevant literature, it is highly recommended that further studies should be conducted in L2 contexts with larger sample sizes to examine the effectiveness of such intervention in L2 settings. Future studies can also use alternative methods of ABM training, proposed by Mogg and Bradley (2018).

## 6. IMPLICATIONS

1. **Reduced Foreign Language Anxiety (FLA):** The ABM intervention could lead to a decrease in FLA levels among adult EFL learners. By targeting and modifying attention biases towards anxiety-inducing stimuli, learners may become less prone to experiencing anxiety in foreign language learning contexts.
2. **Enhanced Learning Performance:** Lower levels of FLA may lead to improved performance in language learning tasks. Reduced anxiety can free up cognitive resources, allowing learners to focus more effectively on the language material.
3. **Increased Language Exposure and Practice:** Lower levels of FLA may encourage learners to engage more actively in language activities both inside and outside the classroom. This could lead to more exposure to the target language and increased opportunities for practice, which are crucial for language acquisition.
4. **Improved Retention and Recall:** Reduced anxiety levels can lead to better retention and recall of learned material. Learners are more likely to remember and use vocabulary, grammar, and other language elements when they are not hindered by anxiety.
5. **Positive Learning Environment:** A decrease in FLA could contribute to a more positive and supportive learning environment. Learners may be more willing to participate in class activities, ask questions, and engage in discussions, which can foster a sense of community and camaraderie among learners.
6. **Increased Motivation and Confidence:** Lower FLA levels can boost learners' motivation and confidence in their language learning abilities. This positive feedback loop can lead to a more proactive and enthusiastic approach to language learning.
7. **Transferable Coping Skills:** The ABM intervention may equip learners with cognitive strategies for managing anxiety in other contexts beyond language learning. These skills could potentially be applied in various real-life situations where anxiety is a factor.
8. **Long-term Benefits for Mental Health:** Learning how to manage and reduce anxiety through ABM may have positive effects on learners' overall mental health and well-being, extending beyond language learning contexts.
9. **Tailored Interventions:** Software-based ABM interventions can be customized to cater to individual learners' specific anxiety triggers and learning preferences. This personalization can make the intervention more effective and applicable to a diverse range of learners.
10. **Research Advancements:** The implementation of ABM in language learning contexts may contribute to the growing body of research on the intersection of technology, cognitive psychology, and language education. It may offer valuable insights into the effectiveness of technology-based interventions in language learning and anxiety reduction.

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