

## Effect of neurofeedback therapy based on virtual reality technology on anxiety in patients with anxiety disorder

Nassrin Rezaie Khosravi<sup>1</sup>, Gelavij Mahmoodi<sup>1\*</sup>

<sup>1</sup> Department of Psychology, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran

**Corresponding author and reprints:** Gelavij Mahmoodi. Department of Psychology, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran

**Email:** g.mahmoudi@iauks.ac.ir

**Accepted for publication:** 30 April 2018

### Abstract

**Background:** Neurofeedback method and virtual reality technology are used as relatively new therapeutic approaches for the treatment of diseases and disorders. The aim of the present study was to investigate the effect of neurofeedback therapy based on the virtual reality technology on anxiety in patients with anxiety disorder.

**Methods:** The present cross sectional study included adolescents with anxiety complaints referring to psychiatrists at the specialized clinic of Kermanshah health center in 2015, April and May. The sampling method was convenience sampling and the sample size was five people. Demographic questionnaire, including information on age, education, marital status, and employment status of patients, and Beck Anxiety Inventory were used to collect the data. Participants were treated with neurofeedback based on virtual reality technology in three sessions. Data were analyzed using IBM SPSS Statistics for Windows, Version 21.0.

**Results:** Participants ranged between 24 and 56 years and all five participants were female (100%). Mean (SD) of anxiety for all participants in the pre-test phase was 37.0 (5.85) while it decreased to 13.6 (6.80) ( $P < 0.01$ ) after the intervention. The results showed that there was a significant difference between the mean anxiety scores in the pre-test phase and the post-test scores at the level of  $P < 0.01$ . In the follow-up phase, the mean anxiety score was 8.6 (3.05) after two months of posttest ( $P < 0.01$ ).

**Conclusion:** According to the results of the study, virtual reality technology based neurofeedback therapy reduces anxiety in people with anxiety disorder.

**Keywords:** Anxiety; Neurofeedback; Virtual Reality; Therapy

**Cite this article as:** Rezaie Khosravi N, Mahmoodi G. Effect of neurofeedback therapy based on virtual reality technology on anxiety in patients with anxiety disorder. SDH. 2018;4(1):78-83. DOI: <https://doi.org/10.22037/sdh.v4i2.20396>

### Introduction

One of the broadest areas of research in the past decades has been the anxiety and its related areas, and yet, there is still ambiguity about the source of anxiety. Types of anxiety can be identified based on its origin. The recent studies have shown that anxiety disorders have the most frequency in the general population (1). All people experience this feeling and tension during periods of life that can be useful or, in some cases, clinical anxiety (2). Anxiety

can lead to failure and incompatibility in a person and deprive him of a large part of his or her capacities. An individual experiences the reduced efficacy when the anxiety increases in him, like the anxiety caused by exam. In fact, anxiety is a kind of negative emotional response that occurs in response to a stressor source such as a test or a competitive situation (3). The existence of this disorder is a factor for helplessness,

disappointment, limitation, and inefficiency and subsequently reducing the motivation, attention, and effort. In various fields, it can cause many problems in terms of relationships, education, productivity, and even death (4).

At first, the virtual reality entered into the digital world as an entertainment tool. This technology provides the user with a virtual environment in order to be able to simulate realities, what he cannot do in the real environment or do not have the necessary conditions to do it in the real environment. One of the most important components of the virtual environment is its visual environment, which presents a real visual experience in front of the user's eyes through displays or special images, but this screen is not a simple phenomenon; it is equipped with sensors that act as a detector. This way, the user feels he is in a 3D environment; this makes the virtual environment even more realistic (5). In the virtual environment, the user can listen to the voices and feel the direction of the sounds using the earphones. Therefore, the virtual reality has no flaw audio-visually, but one of the element of virtual reality is the tactile sense; improvements in the tactile sense simulation have been slower due to limitations in creating a tactile sense in the virtual environment (6).

Neurofeedback can reduce the anxiety and mood disorders by conditioning of brain waves in different age groups. This way, people can reduce their anxiety by focusing on the animation presented in the particular conditions, reduce their anxiety, and increase their relaxation time by repeating the sessions. In protocols that are effective in reducing anxiety, it can be observed that people experience relaxation after about five minutes. An anxious person can exercise his relaxation after learning about his physiological and nervous changes. This method is safe and completely painless and at the same time no harm has been reported. Virtual reality has many interesting advantages and applications in comparison with traditional therapies.

Facing the real environment is an expensive therapy and requires a lot of time for the therapist. It also has other problems, such as lack of easy planning, the security issues, and the confidentiality of treatment sessions. Virtual reality therapy has solved these problems (5).

The virtual reality mode is a new therapy approach wherein flexible environments allow the therapist to design the treatment according to the patient's needs. There are also benefits to older models that include interoperability, flexibility, controllability, confidentiality, security, cost reduction, reduced treatment time, and repeatability. In Iran, no study has been found to assess the effect of neurofeedback based on virtual vision technology on anxiety. Therefore, the aim of the present study was to investigate the effect of virtual reality technology on the anxiety of patients with anxiety disorder.

### Methods

The current cross sectional study included 20 adolescents with anxiety complaints referring to psychiatrists at the clinic affiliated to the Kermanshah Health Center in April and May, 2012. The sampling method was convenience sampling and the sample size was five.

The inclusion criteria for the present study were diagnosis of anxiety based on clinical interviews by a psychologist-psychiatrist and confirmation of the diagnosis using Beck Anxiety Scale, no other treatments (other psychological treatments and drug use) at least one month prior to entering the research, age range of 18-60 years old and having the minimum educational degree (middle school). Also, the exclusion criteria included psychopathological symptoms, drug abuse, psychological disorders except for anxiety and depression and personality disorder, and absences in two treatment sessions.

Demographic information questionnaire was compiled for collecting demographic information for the participants. The questionnaire contained information on

patients' age, education, marital status, and employment status.

#### *Beck Anxiety Inventory*

This is a 21-item scale self-report questionnaire designed to measure the severity of anxiety in adolescents and adults. For each item, the participant chooses one of the four options that indicate the severity of anxiety. Each question is graded from 0 to 3 in the four-party spectrum. This way, if an individual's score is between 0-7, thus he does not have any anxiety. If it is between 8-15, he experiences mild anxiety, if between 16-25, he has moderate anxiety, and if it is between 26-63, it indicates severe anxiety. Each item describes one of the common symptoms of anxiety (mental, physical, and panic symptoms). The coefficient of internal consistency was found to be 0.92 and the reliability with a weekly retest interval was calculated to be 0.75. Also, the correlation coefficient of this scale was calculated to be between 0.30 and 0.76. One research conducted in Iran reported the reliability coefficient of the Beck Anxiety Inventory (BAI) questionnaire as 80% using the retest method within two weeks (7).

At first, Beck Anxiety Inventory was conducted for a number of participants in the study and those with the highest scores

on this scale were included in the study (five people). The treatment sessions were subjected to virtual reality technology for three half-hour sessions of neurofeedback. Participants faced with virtual reality. The glasses were put on the person's eyes with a wide view providing a good view for the eye in a way that the individual does not see anything except for his eyes' space and can easily view the images. The individuals were also taught the relaxation using virtual reality technology, how to use glasses and virtual reality phone, and relaxation with 3D relaxation imagery.

At the fourth session, participants were asked to respond to the Beck Anxiety Inventory again and then the results were compared with those of the pre-test. After two months, the follow-up test was administered once again.

Data analysis was performed in IBM SPSS Statistics for Windows, Version 21.0, and using the mean, standard deviation, and Friedman repeated measures. Level of significance was set at  $P < 0.01$ .

#### **Results**

The age range of participants was between 24 and 56 and all five participants were female (100%). The highest education level was the associate degree and the lowest level was middle school (Table 1).

Table 1. Demographic characteristics of participants based on gender, age, and education

Participant	Age	Education
First one	34	Associate degree
Second one	42	Middle School
Third one	56	Associate degree
Forth one	24	Diploma
Fifth one	43	Diploma

Table 2. Participants' anxiety scores in the pre-test, post-test, and follow-up phases

Participant	Pre-test	Post-test	Follow-up
First one	31	11	8
Second one	42	6	13
Third one	41	16	5
Forth one	42	24	7
Fifth one	31	11	10

Table 3. Participants' panic, mental anxiety, and physical anxiety scores in pre-test, post-test, and follow-up phases

		Panic	Mental anxiety	Physical anxiety
First one	Pre-test	18	0	13
	Post-test	6	1	3
	Follow-up	5	1	2
Second one	Pre-test	16	9	17
	Post-test	2	9	3
	Follow-up	6	0	7
Third one	Pre-test	22	6	13
	Post-test	7	6	7
	Follow-up	2	1	2
Forth one	Pre-test	19	4	19
	Post-test	13	4	10
	Follow-up	5	0	2
Fifth one	Pre-test	17	8	6
	Post-test	7	8	3
	Follow-up	6	1	3

Table 4. Mean and standard deviation of the participants' anxiety score on pre-test, post-test, and follow-up phases

Variable	Test phases		
	Pre-test	Post-test	Follow-up
Anxiety	Mean (SD)	Mean (SD)	Mean (SD)
	37.0 (5.85)	13.6 (6.80)	8.6 (3.05)

Participants 2 and 4 had the highest anxiety levels (42), which decreased significantly after intervention  $P<0.001$  (Table 2).

Panic scores and physical anxiety of participants in pre-test, post-test and follow-up phases decreased (Table 3).

Table 4 shows the mean of anxiety for all participants in the pre-test phase was 37 and after the intervention, it decreased to 13.67. In the follow-up phase, this number was 8.60 after two months of posttest, which indicates the stability of intervention ( $P<0.001$ ).

The results of Friedman Test of anxiety in the sample showed a significant difference ( $P<0.001$ ) among pretest, post-test, and follow-up means. Also, the Chi-Square was calculated to be 40.5.

## Discussion

Neurofeedback therapy based on virtual reality technology has a significant effect

on the reduction of anxiety in the participants of the present research. Considering that no research was found with the title of the present study, similar studies are considered. The results of some previous studies are similar to those of the current study (3, 8-13). González Lorenzo et al. conducted a controlled and randomized study to determine the effectiveness of combined virtual reality exposure therapy with two types of drug therapy in the treatment of 64 patients with agoraphobia disorder. The results showed that in-group comparisons of all groups, including those receiving only drug therapy, recovered in the post-test and follow-up period of six months; that is, no group therapy was superior to another (14). The positive results in the immersive virtual reality group support how an attention-capturing medium such as virtual reality is capable of maximizing the amount

of attention drawn away from the 'real world', allowing patients to tolerate anxious situations. Our results showed that the waiting bay experience could be improved by the addition of these novel technologies. Furthermore, it was also found that virtual reality use could be applied in other stressful situations with similar anxiolytic effects, thereby offering exciting new avenues for research.

Similarly, the recent studies utilizing functional magnetic resonance imaging, a neuroimaging procedure that uses MRI technology to map out brain activity measured by detecting changes associated with blood flow, have provided early suggestions that virtual reality immersion may reduce physiological responses to stressful stimuli (e.g., pain) in addition to the subjective benefit of diverting conscious attention. This may explain the reduced psychological responses observed in the present study (15).

An attractive environment, lack of fear of failure, lack of frustration from disability (8), imagination in motion, and observation of motion are among the positive features of the virtual reality environment, which can increase motivation, encourage the individual, increase the self-esteem, and control one's condition (3). In fact, people with panic tend to face and recognize the panic situations, but it is easier for them to face with the virtual world than the real world. Since this virtual world makes the patient feel competent, fluent, and efficient, it brings him a high sense of endurance and effort, and leads to a greater sense of ability and power because of interacting with the environment. That is why, even with three sessions of therapy, the person's anxiety is reduced very quickly. In neurofeedback therapy, based on the virtual reality technology on anxiety, individuals are trained to identify situations where they feel more anxious and make desensitization by repeating this position. In other words, the person faces his own fears, and there is no need for subjective visualization of the

panic scene and since at the same time a few feelings come into action, the person has no longer problems with subjective visualization and knows what makes him concerned and faces with it.

The current study investigated using a head mounted virtual reality display in the pre-op waiting bay. Virtual reality is a distinctive attention capturing medium capable of maximizing the amount of attention drawn away from the 'real world', allowing patients to tolerate anxious situations. The present study hopefully provides support for the growing body of literature in this area of distraction techniques.

#### *Conflict of interest*

Authors declare no conflict of interests.

#### **References**

1. Dadsetan P. Developmental psychopathology from infancy through adult. Tehran: Samt Publications; 2004.
2. Galbraith T, Heimberg RG, Wang S, Schneier FR, Blanco C. Comorbidity of Social Anxiety Disorder and Antisocial Personality Disorder in the National Epidemiological Survey on Alcohol and Related Conditions (NESARC). *J Anxiety Disord.* 2014; 28(1): 57–66.
3. Gorini A, Marzorati C, Casiraghi M, Spaggiari L, Pravettoni G. A neurofeedback-based intervention to reduce post-operative pain in lung cancer patients: Study protocol for a randomized controlled trial. *JMIR Res Protoc.* 2015; 4(2): e52.
4. Sadeghi A. Anxiety, definition and cause of treatment. Isfahan: Education and Training Publications; 2001.
5. Bahrami F. The comparison cause of anxiety between girl and boy students in Isfahan city. Iran, Tehran: AllameTatabatabei University; 1997.
6. Zhenbo LI, Xiangxu ME, Hui XI. The Research And Implementation of Constructing Complicated Interactive Virtual Scenes. *Journal of System Simulation.* 2002;14(9):1183-7.
7. Kaviani H, Mousavi AS. Psychometric properties of the Persian version of Beck Anxiety Inventory (BAI). *Tehran University Medical Journal TUMS Publications.* 2008;66(2):136-40.
8. Yang X, Malak RC, Lauer C, Weidig C, Hagen H, Hamann B, Aurich JC. Virtual reality enhanced manufacturing system design. In *Proceedings of the 7th CIRP international conference on digital enterprise technology.* 2011;125-133.

9. Botella C, Garcia-Palacios A, Baños RM, Quero S. Cybertherapy: Advantages, Limitations, and Ethical Issues. *PsychNology Journal*. 2009;7(1):77-100.
10. Pensieri C, Pennacchini M. Overview: virtual reality in medicine. *Journal For Virtual Worlds Research*. 2014;7(1).
11. North MM, North S. *Virtual reality therapy*. W S, editor. Cambridge, MA: Academic Press; 2002.
12. Gujjar KR, van Wijk A, Sharma R, de Jongh A. Virtual Reality Exposure Therapy for the Treatment of Dental Phobia: A Controlled Feasibility Study. *Behav Cogn Psychother*. 2018;46(3):367-373.
13. Riva G. Virtual environments in clinical psychology. *Psychotherapy: Theory, Research, Practice, Training*. 2003;40(1-2):68.
14. González Lorenzo M, Peñate Castro W, Pitti González CT, Bethencourt Pérez JM, de la Fuente Portero JA, Gracia Marco R. Efficacy of virtual reality exposure therapy combined with two pharmacotherapies in the treatment of agoraphobia. *International Journal of Clinical and Health Psychology*. 2011;11(2).
15. Mitrousia V, Giotakos O. [Virtual reality therapy in anxiety disorders]. *Psychiatriki*. 2016;27(4):276-286.