A Randomized Controlled Trial of a Neurofeedback-based Training for Improvement in Social Phobia Disorder

Peihua Zhang*, Lin Cheng

ABSTRACT

Objective: to examine the effectiveness of using neurofeedback to improve patients' social phobia. Design and setting: randomized controlled trial, conducted at a counseling center in west china. Participants: 30 patients reporting social phobia were recruited in this study. Interventions: participants were assigned randomly to either a neurofeedback or a non-neurofeedback group. All patients in both groups received the same traditional training except for neurofeedback. The neurofeedback group received 45 minutes of neurofeedback, twice a week for six sessions. Measures and finding: the measure of this study was the Social Phobia Inventory (SPIN), which was administered before and after the program. Using a 2 × 2 MANOVA, the changes in mean SPIN were significantly higher in the neurofeedback group than in the non-neurofeedback group. Conclusions: a training program involving neurofeedback significantly improved the social phobia. Implications for practice: Consultants involved in social phobia patients care who are interested in complementary therapies should be encouraged to obtain learning in neurofeedback technique and teach patients' families in clinical settings.

Key Words: Neurofeedback, Training Program, Social Phobia Disorder, Fear of Negative Evaluation, Social Avoidance and Distress

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Introduction

Social phobia, known as social anxiety, is constant fear of negative evaluation by others; patients with social phobia are strongly afraid of being humiliated and embarrassed in specific social situations, such as conversation in a community (Ruscio *et al*., 2014). The fear may appear as a concern for about anxiety symptoms such as blush, tremor, and sweating. The prevalence of social phobia has been reported to be between 3% and 13% in lifetime, and the peak of the onset of this disorder is the second decade of life (APA, 2000). According to the epidemiological studies, fewer than 15% of these patients seek treatment (Toit and Stein, 2002). Social phobia disorder has a high morbid comorbidity with other anxiety disorders, mood disorders, and drug abuse disorders (Smith and Book, 2008). Recent studies show that 81 percent of people with social anxiety disorder have another disorder (Den Boer, 2000). The rate of recovery for social phobia without treatment is low, and if there is a personality disorder (Mainly an avoidance personality disorder) and a generalized social anxiety disorder, this will be less (Coelho, Cooper & Murray, 2007).

All cognitive theories refer to the role of an important factor in the creation and maintenance of social anxiety disorder, and that is the bias of information processing (Hofmann, 2007). Studies suggest that patients with social phobia are characterized by biases in the

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following cases: the negative interpretation of external social events, the discovery of negative responses from others, the imbalance of attention between external processing and self-centered processing, the use of internal information to build a mindset about how it looks from the eyes of others, reminding negative information about its functions as well as a variety of post-event processing and prediction of failure before confronting the situation (Clark and McManus, 2002).

Investigating the relationship between brain thalamic cortical mechanisms and psychological states shows that optimal changes in the rhythm and frequency of brain waves by nerve therapies, optimal changes are made in individual's neuropsychological conditions (Caviness *et al*., 2015; Shanshan and Zichao, 2017; Wang, 2017). Neurofeedback, as one of the nerve therapies, can make people aware of brain cortical activities (Marzbani *et al.,* 2016). Neurofeedback improves the performance of individuals using brain wave changes (Oh and Song, 2016). In fact, neurofeedback has the advantage of suppressing over-amplitude excessive waves and amplifying below-amplitude waves that these changes relate to neuropsychiatric disorders. Based on the type of disorder, the effect of neurofeedback is related to specific regions of brain (Staufenbiel *et al*., 2014). Neurofeedback is used to treat epilepsy, anxiety, depression, hyperactivity disorder, learning disorder, drug abuse disorder, and exercise development (Surmeli and Ertem, 2009). Neurofeedback, as a safety and non-invasive method, causes the growth and development of brain cells (Bagdasaryan and Le Van Quyen, 2013). Due to the existence of neurophysiologic problems in social anxiety disorder and the confirmation of neuropsychology application and effectiveness in anxiety improvement, and experts' opinion, neurofeedback is a process that involves two major branches of psychology (conditioning and functional neurology of brain) and deserves more attention and importance from the scientific community of psychology and psychiatry.

The aim of this study was to evaluate the efficacy of neurofeedback in improving perceived fear during the social situations. We used the variables fear of negative evaluation and social avoidance and distress as an indicator of perceived (Watson and Friend, 1969; Antony *et al*., 2006). Also, we used the variable controlled brain waves as an important brain-related outcome (Tansey and Bruner, 1983; Othmer and Kaiser, 1998). We hypothesized that neurofeedback training would improve controlled brain waves (hypothesis 1), fear of negative evaluation (hypothesis 2) and social avoidance and distress (hypothesis 3).

Methods

Study design

Our study used an experimental 2 (experimental-control) × 2 (pretest-posttest) design that assigned participants randomly into intervention (neurofeedback) and control (non-neurofeedback) groups. We distributed the sample evenly to the neurofeedback and non-neurofeedback groups using a computer-generated unrepeated randomization list. Patients in the neurofeedback group received 45 minutes of neurofeedback, from 4:00 PM to 4:45 PM, twice a week for six sessions, while patients in the non-neurofeedback received only traditional training with no neurofeedback. The both groups receive the same training, except for neurofeedback training.

Sample and setting

All patients participated in the both groups were selected from one consulting centers in west china. The inclusion criteria were: a confirmed diagnosis of social phobia illness, age 20-50, not participating in other therapeutic interventions. This study was approved by one of the Behavioral Disease Counseling Centers. The patients with social phobia disorder participated in the neurofeedback group received about $90 for taking part in the experiment. The neurofeedback-based training intervention was learned and practiced to participants in the neurofeedback group, but no for the non-neurofeedback group.

Data collection procedures

We solicited a consecutive sample from one consulting center in west china. We obtained once permission and assessed patients with social phobia by the Social Phobia Inventory (SPIN) to determine if they met the study criteria. If the patients met the inclusion criteria, we randomly assigned them to either a neurofeedback group or a non-neurofeedback group. All patients involved in the neurofeedback and non-neurofeedback groups also agreed to complete the other study measures and we administered before the neurofeedback training and after the neurofeedback training.

Controlled brainwaves were measured by Quantitative Electroencephalography (QEEG), which consists of EEG software. In this research, the brainwaves were recorded using a 19-channel Russian-made EEG machine and helmet. The brainwaves record was performed in a quiet room and at rest with closed eyes for 5 minutes at 250Hz sampling rate.

Neurofeedback training program

The sample flow and analysis was shown in Fig. 1. We developed the neurofeedback training program with respect to another neurofeedback intervention, which has been shown to have a positive effect on perceived fear in the recent studies (Moradi et al., 2011). The program aims to change brain function through training. To make the changes, in the neurofeedback treatment sessions, the electrodes were arranged in the intersection of skull bone surfaces according to the 10-20 system, and the distance between the other intermediate electrodes was based on 20 and 10% distance. The protocol for this study was conducted in the PZ area. According to this protocol, to collect baseline data, two electrodes were connected to the reference ears as well as a main electrode to the head in patient's CZ, and for treatment, two electrodes were connected to the ear as well as the main electrode to the head in PZ section (alpha-theta protocol). The alpha-theta protocol was performed in 12 sessions, each session 45 minutes.

Statistical analysis

Statistical analysis was performed using a 2 × 2 MANOVA with the measures SPIN and QEEG to examine the effects of Time (before-after the neurofeedback training program) and Group (neurofeedback-non neurofeedback group) on the dependent variables fear of negative evaluation, social avoidance and distress, and controlled brainwaves.

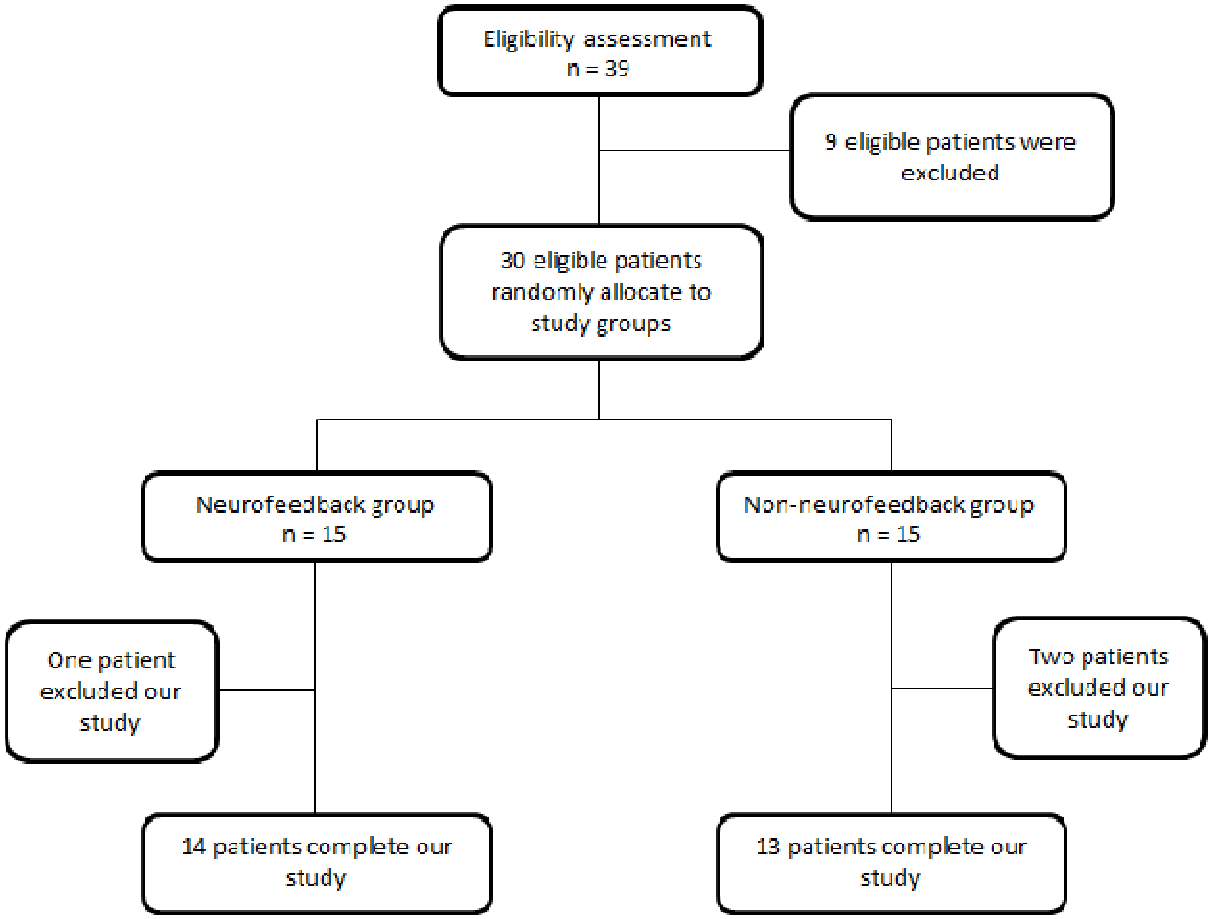

Figure 1. Selection of participants through each trial stage

Results

Sample characteristics

After assessing thirty nine patients for eligibility, nine of them were excluded because of a social phobia score less than average. Thirty eligible patients with social phobia randomly were allocated to the neurofeedback group (n = 15) and non-neurofeedback group (n = 15). The neurofeedback group lost one patient and the non-neurofeedback group two patients. This resulted in 14 patients with social phobia in the neurofeedback and 13 patients in the non-neurofeedback group (Fig. 1).

According to the finding in Table 1, the mean age of the sample was 29.9 (SD = 3.64) years. Most participants were female (n = 17, 63%) and had a high level of education (n = 18, 67%) and a Caucasian/white race (n = 17, 63%).

The effect of neurofeedback on fear of negative evaluation was measured using the SPIN. At baseline (directly before the training program), the mean SPIN score for the neurofeedback group was 1.18 (SD = 0.74), compared with 1.21 (SD 0.48) for the non-neurofeedback group. Two weeks after the training program, mean SPIN score for the neurofeedback group had significantly declined to 0.53 (SD = 0.66), and it for the non-neurofeedback group had significantly increased to 1.71 (SD = 0.59) (Fig. 2).

Further, the effect of neurofeedback on social avoidance and distress was measured using the SPIN. At baseline (directly before the training program), the mean SPIN score for the neurofeedback group was 0.94 (SD = 0.81), compared with 1.04 (SD = 0.67) for the non-neurofeedback group. Two weeks after the training program, mean SPIN score for the neurofeedback group had significantly declined to 0.51 (SD = 0.92), and it for the non-neurofeedback group had significantly increased to 1.36 (SD = 0.71) (Fig. 3).

Controlled brainwaves increased in the neurofeedback group, pre-training: M = 1.26, SD = 1.23, and post-training: M = 1.64, SD = 1.41, and remained stable in the non-neurofeedback group, pre-training: M = 1.32, SD = 1.35, and post-training: M = 1.31, SD = 0.37.

Discussion

Fig. 1 showed that a large number (77%) of participants had high social phobia. The mean SPIN score for the variable fear of negative evaluation was 1.18 in the neurofeedback group and 1.21 in the non-neurofeedback group. Further, the mean SPIN score for the variable social avoidance and distress was 0.94 in the neurofeedback group and 1.04 in the non-neurofeedback group. These results show that patients with social phobia experience a significant fear of negative evaluation and social avoidance and distress during the social situations. Previous studies have indicated that high social phobia is related to fear of negative evaluation and social avoidance and distress (Conoor, 2000).

Table 1. Characteristics of participants (age, gender, race, and education)

Variables		All participants (n = 27)		Neurofeedback group (n = 14)		Non-neurofeedback group (n = 13)	
		n	%	n	%	n	%
Age, mean (SD)		29.9	3.64	29.7	2.97	29.6	3.08
Gender	Male	10	37	5	36	4	31
	Female	17	63	9	64	9	69
Race	African American	5	19	2	14	3	23
	Caucasian/white	17	63	10	72	7	54
	Multiracial	3	11	1	7	2	15
	Other/not reported	2	7	1	7	1	8
Education	High school/Vocational	9	33	3	21	4	31
	College, University/Graduate school	18	67	11	79	9	69

Table 2. Average scores and standard deviations of the neurofeedback group and non-neurofeedback group

Variable	Neurofeedback group (n=14)				Non-neurofeedback group (n=13)			
	Pre-training		Post-training		Pre-training		Post-training	
	M	SD	M	SD	M	SD	M	SD
Fear of negative evaluation	1.18	0.74	0.53	0.66	1.21	0.48	1.71	0.59
Social avoidance and distress	0.94	0.81	0.51	0.92	1.04	0.67	1.36	0.71
Controlled brainwaves	1.26	1.23	1.64	1.41	1.32	1.35	1.31	0.37

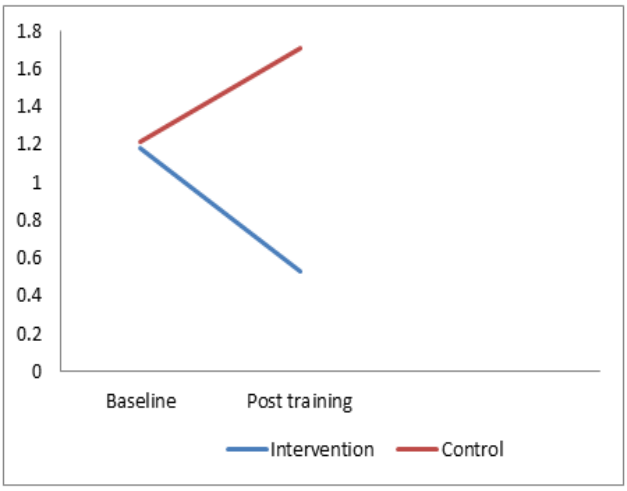

Figure 2. Changes in fear of negative evaluation over time at baseline and post-training

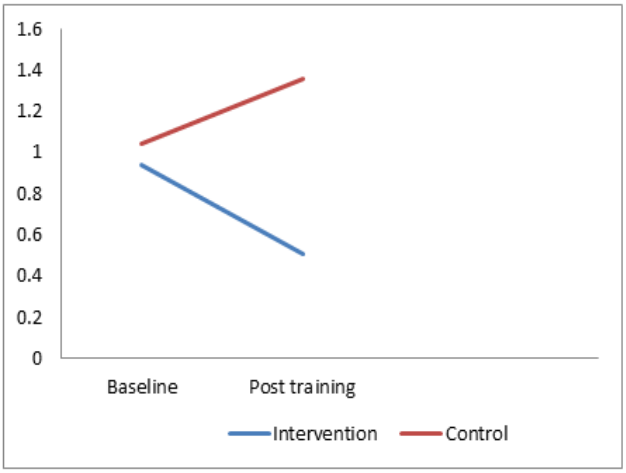

Figure 3. Changes in social avoidance and distress over time at baseline and post-training

This study shows that high social phobia in the neurofeedback group improved significantly compared with the non-neurofeedback group. This result is consistent with previous neurofeedback study results, showing that neurofeedback can effectively improve social anxiety (Zilverstand *et al.*, 2015; Biriukova *et al.*, 2003; Wells and Papageorgiou, 2001). In explaining this finding, people with social anxiety tend to construe the judgment of others as threatening, extreme and catastrophic, and that's why they are afraid of being in a social position and fearing to be negatively evaluated by others. They look at themselves from the perspective of an outside observer and use the internal information for the extreme interpretation of what they look like from the perspective of others (Spokas *et al.*, 2007; Mansell *et al.*, 1999). On the other hand, they concentrate on the specific symptoms appearing in others and interpret the symptoms in a negative way and attribute to their own weaknesses, and consequently, these lead to a high anxiety and poor performance (Wells and Papageorgiou, 2001).

In recent years, due to observation of brain abnormalities in patients with anxiety, the treatment has been proposed using the neurofeedback method. In anxiety states, the brain reacts through excessive consciousness. Anxiety is an aspect of brain self-regulation reduction, and the anxiety states are quite evident in the EEG. When the brain is involved in self-regulation, so it heals, and this is possible by strengthening brain waves. When the brain is strengthened in self-regulation, the physiological stimulation mechanism speeds up, and the brain is not vulnerable to anxiety. Anxiety disorders lead to a defect in brain waves, and the increase of alpha-theta leads to increased performance under stressful conditions. Physiological responses affect adults with social anxiety disorder as a tear, excessive sweating, and heart disease, and disrupt their work. In fact, neurofeedback teaches self-regulation to the brain during a process and helps the person through conditioning to compromise mental responses and better earn the anxiety control skills. The new skills, acquired consciously and unknowingly, are internalized during the training and are automatically transmitted to the individual's daily activities. Therefore, neurofeedback helps the brain to learn how to eliminate the functional defects.

Conclusion

This is the first experimental study on the effects of brainwaves on social anxiety phobia disorder. Results show that training program involving brainwaves is more effective in social anxiety phobia disorder than traditional training. Consultants involved in social phobia patients care who are interested in complementary therapies should be encouraged to obtain learning in neurofeedback technique and teach patients' families in clinical settings.

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