World Psychology, 3(2) - August 2024 339-359

E-ISSN 2830-4764
P-ISSN 2830-4551

The Role of Neurofeedback in the Treatment of Post-traumatic Stress Disorder: A Neuro Psychological Perspective

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Article Information:
Received Sep 17, 2024
Revised Sep 26, 2024
Accepted Oct 10, 2024

ABSTRACT

Post-Traumatic Stress Disorder (PTSD) treatment using neuropsychology has come a long way. Neurofeedback, also called EEG biofeedback, is a technique that teaches the brain to regulate its own electrical activity. Using an EEG, or electroencephalogram, device, one can see brain activity in real-time and be trained to change unbalanced or abnormal brain wave patterns. This study was conducted to determine the purpose of neurofeedback, which serves to control this brain activity in a way that is comfortable and suited to the individual. The method used by researchers in examining the Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective is to use quantitative methods. The data obtained by researchers were obtained from the results of distributing questionnaires. The results of the data acquisition will also be tested again using the SPSS application. From the results of the study, it can be seen that from a neuropsychological perspective, neurofeedback aids the restoration of healthy brain function through repeated and consistent learning. This process is known as neuroplasticity, where the brain reshapes and strengthens neural connections made by new experiences and practice. Therefore, neurofeedback not only reduces PTSD symptoms, but also aids in long-term recovery and improves one's quality of life. Researchers can conclude that from a neuropsychological point of view, neurofeedback is not only considered as a therapeutic tool, but also as an entry point to understanding and modulating human brain function during recovery from trauma.

Keywords: *Neurofeedback, Psychological, PTSD*

Journal Homepage https://ejournal.staialhikmahpariangan.ac.id/Journal/index.php/wp/

How to cite: Mujahidah, Mujahidah., Marlina, E., Aini, N, A., Hasnawati, S & Harahap, M, A (2024). The Role of Neurofeedback in the Treatment of Post-traumatic StressDisorder:

A Neuro Psychological Perspective. *World Psychology*, 3(2), 339-359. https://doi.org/10.55849/wp.v3i2.703
Published by: Sekolah Tinggi Agama Islam Al-Hikmah Pariangan Batusangkar

INTRODUCTION

Post-Traumatic Stress Disorder (PTSD) is a description of a debilitating mental health condition that can affect a person who has experienced a traumatic or life-threatening event such as war, sexual and physical aggression, childhood abuse and neglect, natural destruction, and abuse (Viard et a

l., 2019). PTSD is characterized by re-experiencing the traumatic event, avoiding stimuli associated with the trauma, increased arousal, and experiencing negative changes in mood and cognition (Jones et al., 2018). Even though the traumatic event happened a long time ago, people with PTSD have intrusive thoughts and feelings related to the event (Stein et al., 2018). They may remember the event through flashbacks or nightmares. As a result, PTSD sufferers often experience sadness, fear, anger, and even reluctance to interact with others (Soder et al., 2019).

A person who receives a diagnosis of PTSD will inevitably suffer from having to re-experience the traumatic event, either through stories, witnessing it happen to someone else, or knowing that it happened to someone close to them (Perez-Garcia et al., 2018). In addition, small details of the traumatic event are remembered when a diagnosis of PTSD is made. PTSD can affect the emotional health of a sufferer, so it should not be ignored (Kataoka et al., 2019). In general, the symptoms of PTSD fall into four categories, the first being disturbing thoughts. These thoughts can be recurring memories that occur involuntarily, disturbing nightmares, or flashbacks of the traumatic event (Van Der Kolk et al., 2019). PTSD sufferers find the flashbacks so real that they feel as if they are replaying the traumatic event or seeing it right in front of their eyes (Santhanam et al., 2019).

Furthermore, the second symptom of PTSD is avoiding things that remind of traumatic events. This means that PTSD sufferers often avoid things that can remind them of the traumatic event (Priebe et al., 2018). This may be demonstrated by avoiding people, places, activities, objects or situations that may remind them of the traumatic event. They refuse to talk about the situation or how they felt about the traumatic event (Patterson et al., 2019). The third symptom is altered thoughts and moods. These include the inability to remember important aspects of the traumatic event and the emergence of intrusive negative thoughts and feelings about the person (Van Woudenberg et al., 2018). PTSD sufferers also tend to experience excessive shyness and blame themselves or others (Bryant et al., 2019). In addition, they are less interested in activities they enjoy and prefer to live alone.

The fourth symptom is emotional changes. The latter include sloppy behavior, being overly aware of surroundings and being suspicious, being easily startled, problems concentrating, and insomnia (Meli et al., 2019). PTSD can be diagnosed in people of all ages, but there are several factors that can increase the likelihood of developing PTSD, such as experiencing severe or long-term trauma, having experienced

previous trauma, such as childhood abuse, having a job that always involves risk, and so on (Leightley et al., 2019). Some people experience PTSD, while others do not, but experience the same traumatic event (Fear et al., 2018). his may be because people with PTSD tend to avoid thoughts about traumatic events or are reluctant to talk about them, whereas people without PTSD are more willing to face thoughts and talk about them (Wang et al., 2018).

PTSD can be treated with medications and psychological therapies, one of which is neurofeedback (Seo et al., 2019). A type of biofeedback often called EEG-biofeedback is neurofeedback. While biofeedback is used to measure and control bodily functions such as hand temperature, muscle tension, and heart rate variations, neurofeedback concentrates on training activity directly in the brain (James & Todak, 2018). The results led to the development of customized protocols to meet the unique needs of patients. Sensors are attached to patients' scalps during neurofeedback therapy to track their brainwaves (Karam et al., 2019). For the most part, this activity is categorized as "slow" or "fast" brain waves. The presence of these markers of too slow or fast brainwaves can cause problems for someone with PTSD or other stress disorders (Rosellini et al., 2018).

The brainwave patterns of a person suffering from PTSD can be improved through neurofeedback therapy, which allows for higher alpha or beta waves (Biswas & Ray, 2019). While alpha waves are important for achieving relaxation, beta waves are also important for organization, follow-through, focus, and basic learning functions (Young et al., 2018). Therefore, ensuring alpha waves occur frequently enough is important for overall well-being. Neurofeedback for PTSD is not only much safer than invasive, drug-based PTSD treatment, but also more effective in the long run (Misaki et al., 2019). A person who completes a neurofeedback protocol in a medical setting can continue to use the techniques they have learned during treatment and can experience long-term symptom improvement without the need for additional treatment or boosters (Zhigalov et al., 2019).

From a neuropsychological point of view, Neurofeedbeck therapy offers an innovative approach to address PTSD by utilizing the principles of neuroplasticity (Jurewicz et al., 2018). The brain's ability to form new connections and change its structure and function in response to experience and learning is known as neuroplasticity (Sudnawa et al., 2018). In the case of PTSD, neuroplasticity can help the brain recover from trauma. By utilizing the principles of neuroplasticity, the brain's ability to change and adapt. The goal of this therapy is to change non-adaptive brain activity patterns into more adaptive ones (Pei et al., 2018). Therefore, it is crucial to be aware of the stigma associated with PTSD and address these negative perceptions (Lorenzetti et al., 2018). Better education and understanding of these conditions can help reduce stigma and encourage people to get the help they need.

The type of method used in this research is quantitative method. This method is used so that the final results of data processing can be known clearly and precisely about the Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A

Neuro Psychological Perspective (Agnoli et al., 2018). The data collection process is obtained by researchers from the results of respondents' answers that researchers have done. Researchers made a questionnaire of 10 questions, then distributed it through goggle from. After the data is collected, the data will be calculated into a percentage and presented in tabular form. In processing research data, researchers use SPSS software which aims to make it easier for researchers to process data, and the data results are more relevant. Furthermore, the researcher really hopes that the next researcher will examine and study more deeply the role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective

RESEARCH METHOD

Research Design

In researching The Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective, using quantitative methods. The use of quantitative methods aims to collect research data and test hypotheses that have been formulated (Gupta et al., 2018). Then the researcher made a questionnaire made in the Google From application which was distributed online to respondents via the WhatsApp application. The questionnaire contains 20 questions asked by the researcher. To fill out the questionnaire, the researcher has provided four options, namely strongly agree, agree, disagree, and disagree. So the respondents can respond to the questions asked by the researcher by choosing the four options.

Research Procedure

In this study, researchers investigated the Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective. The purpose of the researcher is to investigate this so that the researcher can collect, analyze, and provide understanding of the data that has been collected. In making questions, researchers use language that is good and easy for respondents to understand when filling out the questionnaire distributed by researchers later. It is intended that respondents who provide their responses to the questions asked by the researcher can be answered quickly. That way, researchers will find it easier to examine the data being investigated regarding the Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective (Välikangas et al., 2016).

Research Subject

In researching The Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective, researchers certainly determine the subjects for their research. In this study, the subject in this study was addressed to someone who had experienced PTSD who was chosen by the researcher randomly. As for before the distribution of the questionnaire was carried out by the researcher, the researcher asked for the willingness of the respondents in advance to be able to take the time to fill out the questionnaire that the researcher would distribute. The questionnaire contains 10 questions each that are in accordance with the topic of research on the Role

of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective.

Research Ethics

In order to maintain public trust, ensure scientific validity, and protect the rights of people participating in research, research ethics are essential for researchers to maintain. Research ethics is known as a set of ethical principles that govern how people act and make decisions during research (Sochacka et al., 2018). The purpose of ethics is to ensure that research is conducted in a way that is fair, responsible, and respects the rights and welfare of all parties involved. In addition, researchers also provide up-to-date information about their research to maintain their commitment (Foot et al., 2018). The researcher did this in order to get maximum research results, and remain consistent in developing better research patterns with the research he did.

Data Collection and Analysis

This time, researchers used quantitative methods for research data collection. The researcher also used a T-test as previously mentioned by the researcher. The purpose of this data collection is to find relationships and become a benchmark between the research object material entitled The Role of Neurofeedback in the Treatment of Post-Traumatic Stress Disorder: A Neuro Psychological Perspective (Prokopy et al., 2019). The researcher also conducted advance testing using SPSS software to ensure that the respondents' responses were highly accurate and reliable. Thus, researchers must be very careful when collecting processed data.

Tabel 1

Categories of Cognitive Improvement Through Non-Invasive Brain Stimulation Techniques in Healthy Adults

No	Earning Category	Respondent Subject	Percentage (%)
1	Earning Category	PTSD Patient	>90%
2	Strongly agree	PTSD Patient	45-89%
3	Agree Disagree	PTSD Patient	16-45%
4	Disagree Don't agree	PTSD Patient	5-15%

Figure 1

Data Collection and Analysis Flow

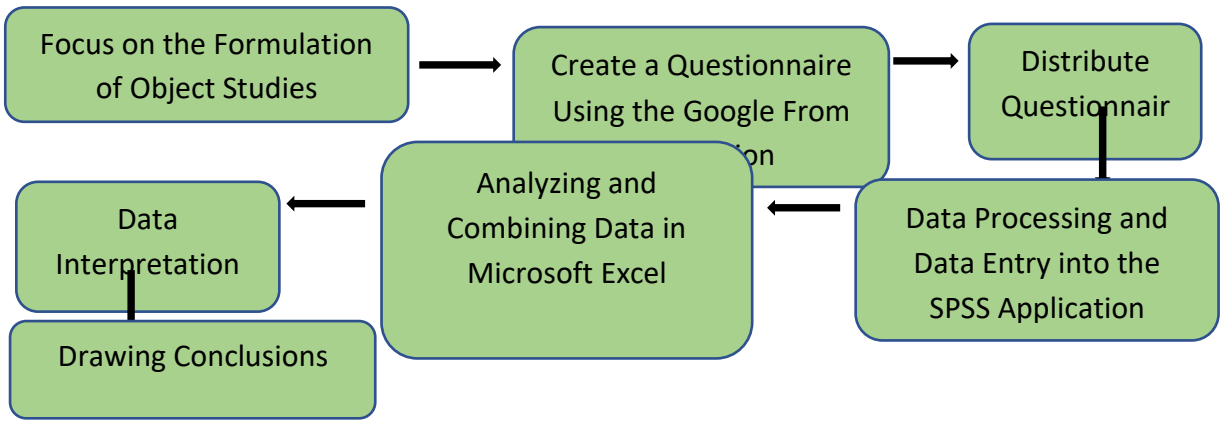

Figure 1 above shows how researchers collect and analyze research data. The results of data acquisition came from respondents' answers to the researcher's questions. Furthermore, in the quantitative research method, the researcher will also test again using the T-test which will be used to enter research data into the SPPS application. The number of questions asked by the researcher was 20 questions, where each question was divided into ten questions with different questions. Only after the questionnaire is distributed can researchers formulate and draw conclusions from the research object.

RESULTS

The Role of Neurofeedback in the Treatment of Post Traumatic Stress Disorder: A Neuro Psychological Perspective

Neurofeedback therapy uses EEG technology to help people manage and change their brain activity. It is used for disorders such as ADHD, ADD, OCD, depression, anxiety disorders, sleep difficulties, and other behavioral deviations. During this process, a biofeedback sensor is inserted into the ear or finger and connected to a computer. These sensors measure body changes, such as skin changes and heart rate, and then display the data in graphical form. These charts help people control stress, relax muscles, and think positively about their ability to overcome problems. Additionally, neurofeedback therapy can be used to improve the quality of life for people suffering from mental health disorders. This therapy has been shown to reduce symptoms of ADHD, depression, and anxiety disorders in some cases. Neurofeedback can also help people with migraines and insomnia to reduce the intensity and frequency of their symptoms. Thus, neurofeedback therapy is an effective form of therapy that helps improve brain function through the use of EEG technology to measure and manage brain activity. Thus, individuals suffering from mental health disorders may experience fewer symptoms and have a better quality of life.

Table 2

Summary of Percentage Results from Respondents' Answers

No.	question	Strongly Agree	Agree	Disagree	don't agree
1	Neurofeedback is a non-invasive method that has the potential to reduce symptoms of post-traumatic stress disorder (PTSD).	30%	60%	10%	0%
2	Neurofeedback is a therapeutic method that aims to change brain activity by providing direct feedback to individuals.	55%	45%	3%	2%
3	Neurofeedback therapy is an effective therapy in treating PTSD by using EEG technology to measure and manage brain activity	45%	50%	5%	0%

4	Neurofeedback treatment can help individuals with PTSD to reduce post-traumatic stress symptoms	52%	33%	10%	5%
5	Neurofeedback therapy uses biofeedback sensors attached to a finger or ear to measure physiological changes in the body.	40%	40%	10%	10%
6	Biofeedback sensors measure heart rate activity, skin changes, and other changes to provide visual feedback that helps individuals manage stress.	50%	35%	10%	5%
7	Neurofeedback therapy helps individuals with PTSD to reduce symptoms of impulsivity and hyperactivity.	40%	40%	10%	10%
8	Neurofeedback therapy is effective in stabilizing mood and reducing symptoms of depression.	45%	45%	5%	5%
9	Neurofeedback therapy can help individuals with PTSD to reduce insomnia symptoms and improve sleep quality.	35%	55%	7%	3%
10	The use of neurofeedback in PTSD therapy can help individuals reduce symptoms of anxiety and anxiety.	60%	30%	6%	4%

Table 2 above shows the distribution of questionnaires that have been carried out by researchers. This questionnaire contains ten questions about the role of neurofeedback in the treatment of post-traumatic stress disorder: a neuro-psychological perspective. In addition, during the distribution of the questionnaire, the researcher has presented a percentage of each response from the respondents. Therefore, respondents can choose to answer the researcher's questions by providing options such as strongly agree, agree, disagree, or disagree. And it can also be seen from the first question asked by researchers regarding Neurofeedback, which is a non-invasive method that has the potential to reduce symptoms of post-traumatic stress disorder (PTSD), getting the highest score of 60% agree options.

The second question about Neurofeedback is a therapy method that aims to change brain activity by providing direct feedback to individuals, getting a percentage result of 3% disagreeing. The third question about Neurofeedback therapy is an effective therapy in treating PTSD using EEG technology to measure and manage brain activity, getting a score of 50% agree. The fourth question about neurofeedback treatment can help individuals with PTSD to reduce post-traumatic stress symptoms received a percentage gain of 33% agreeing. Next, the fifth question: Neurofeedback therapy uses biofeedback sensors attached to the finger or ear to measure physiological changes in the body. There were as many as 40% of the strongly agreed option. Next,

the sixth concerns biofeedback sensors measuring heart rate activity, skin changes and other changes to provide visual feedback that helps individuals manage stress, as many as 10% disagree.

The seventh question, that Neurofeedback therapy helps individuals with PTSD to reduce symptoms of impulsivity and hyperactivity, obtained a percentage result of 40% choosing the agree option. In the eighth question, neurofeedback therapy is effective in stabilizing mood and reducing symptoms of depression, also found in the agree option as much as 45%. Question nine Neurofeedback therapy can help individuals with PTSD to reduce insomnia symptoms and improve sleep quality, getting a percentage result of 55% who agreed. For the last question regarding the use of neurofeedback in PTSD therapy can help individuals reduce symptoms of anxiety and anxiety, the percentage obtained was 60% for the strongly agree option.

Table 3

Summary of Percentage Results from Respondents' Answers

No.	question	Strongly Agree	Agree	Disagree	don't agree
1	Neurofeedback therapy uses Brain Mapping to identify abnormal brain activity patterns and change them to become more normal.	55%	35%	8%	2%
2	Neurofeedback therapy can help individuals with PTSD to improve concentration and reduce ADHD symptoms.	40%	50%	4%	6%
3	Neurofeedback therapy is effective in reducing migraine symptoms and other behavioral aberrations.	45%	45%	5%	5%
4	The use of neurofeedback in PTSD therapy can help individuals reduce symptoms of anxiety and anxiety.	55%	45%	0%	0%
5	Neurofeedback therapy can help individuals with PTSD to reduce depressive symptoms and improve mood.	45%	50%	5%	0%
6	Neurofeedback therapy is effective in reducing insomnia symptoms and improving sleep quality.	42%	53%	2%	3%
7	Neurofeedback therapy uses biofeedback sensors to measure physiological changes in the body and provide visual feedback that helps individuals manage stress.	38%	42%	5%	15%
8	Biofeedback sensors measure heart rate	45%	40%	10%	5%

	activity, skin changes, and other changes to provide visual feedback that helps individuals manage stress.				
9	Neurofeedback therapy can help individuals with PTSD to reduce symptoms of impulsivity and hyperactivity.	45%	45%	8%	2%
10	Neurofeedback therapy can help individuals with PTSD to reduce insomnia symptoms and improve sleep quality.	67%	30%	0%	3%

In the statement in table 3 above, the researcher has also created ten questions. Which can be seen from the first question regarding Neurofeedback therapy using Brain Mapping to determine abnormal brain activity patterns and change them to be more normal, getting a percentage result of 35% of agree options. Next, question number two about Neurofeedback therapy can help individuals with PTSD to improve concentration and reduce ADHD symptoms, getting a strongly agree option percentage score of 40%. The third question, that Neurofeedback therapy is effective in reducing migraine symptoms and other behavioral deviations, received a percentage score of 45% strongly agree.

The fourth question regarding the use of neurofeedback in PTSD therapy can help individuals reduce symptoms of anxiety and anxiety, getting as much as 45% of the percentage score in the agree option. The fifth question about Neurofeedback therapy can help individuals with PTSD to reduce depressive symptoms and improve mood, getting as many as 45% of the options strongly agree. Question six Neurofeedback therapy is effective in reducing insomnia symptoms and improving sleep quality, also getting a percentage gain of 53% in the agree option.

Furthermore, the seventh regarding Neurofeedback therapy uses biofeedback sensors to measure physiological changes in the body and provide visual feedback that helps individuals manage stress, getting a percentage score of 38% strongly agree. The eighth question about Biofeedback sensors measures heart rate activity, skin changes, and other changes to provide visual feedback that helps individuals manage stress, getting a percentage gain of 45% strongly agree. In question number nine, Neurofeedback therapy can help individuals with PTSD to reduce symptoms of impulsivity and hyperactivity, which was also found to be the most agreed option with 45%. The final question about Neurofeedback therapy can help individuals with PTSD to reduce insomnia symptoms and improve sleep quality, getting as many as 55% of the options strongly agree.

Diagram 1

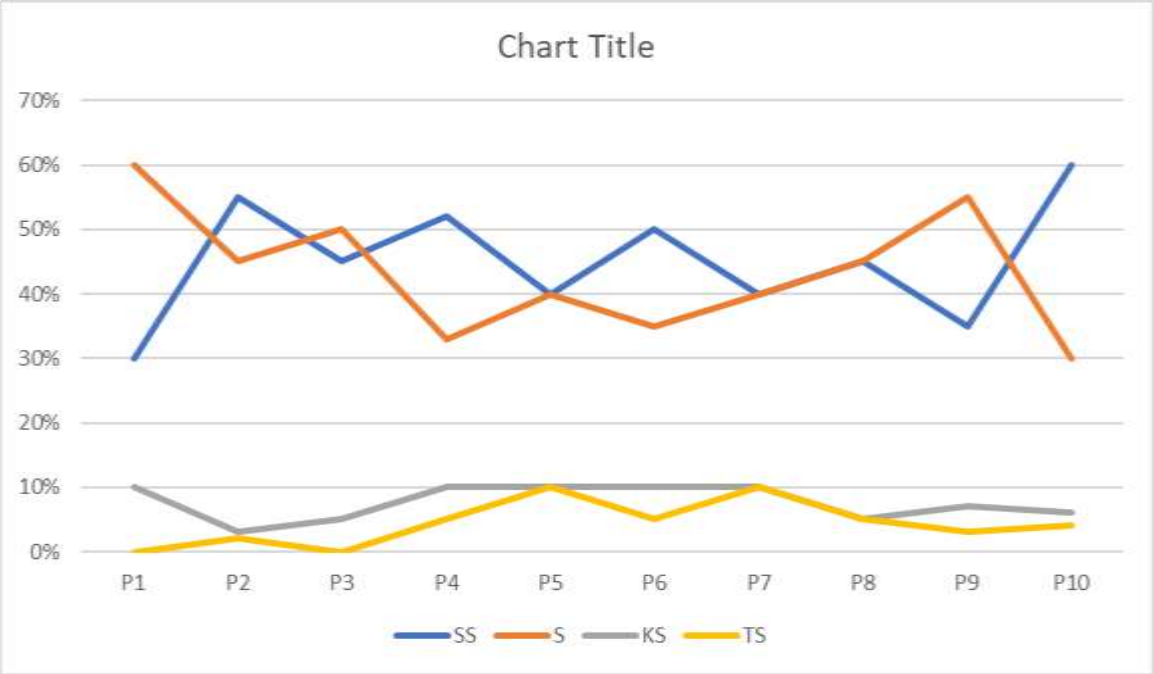

Diagram 2

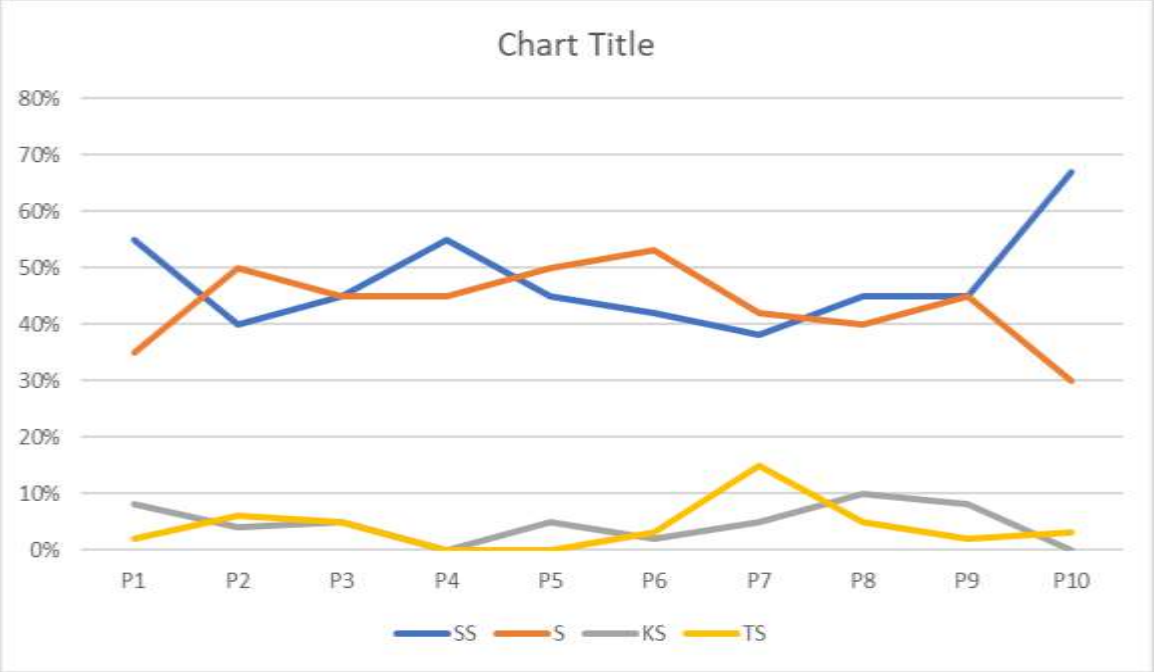

Table 3

T-test Regarding the Role of Neurofeedback in the Treatment of Post Traumatic Stress Disorder: A Neuro Psychological Perspective

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	46.9500	20	8.47582	1.89525
	POST TEST	43.4000	20	8.24238	1.84305

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	-.700	.001

Paired Samples Test

		Paired Differences				
					95% Confidence Interval Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	3.55000	15.41522	3.44695	-3.66454	10.7645

Based on the results of table 3 above, it is a T-test using the SPSS application. From the research results, the researcher can conclude that the T-test in the first output section explains the mean as the average. In the Pre Test the average number produced was 46.9500, while in the Post Test the result was 43.4000. Based on these results, it can be formulated that there are differences in the results of the respondents' answers. Next, in the Paired Samples Correlations section, you get a correlation of -.700, and the sign size is 001. Next, in the Paired Samples Test section, we obtained a result of 15.41522 in the Std section. Deviation, while in the Std. Error Mean obtained a result of 3.44695. Based on these results, regarding the role of neurofeedback in the treatment of posttraumatic stress disorder: a neuropsychological perspective.

Table 4

T-test Regarding the Role of Neurofeedback in the Treatment of Post Traumatic Stress Disorder: A Neuro Psychological Perspective

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	6.1500	20	3.32890	.74436

	POST TEST	4.2500	20	3.83715	.85801

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	.269	.252

Paired Samples Test

		Paired Differences				
					95% Confidence Interval Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	1.90000	4.35165	.97306	-.13663	3.93663

Furthermore, in table 4, there are also the results of research using the T-test. It can be seen in the first output section that the Pre Test results were 6.1500, and the Post Test results were 4.2500. In the Paired Samples Correlations section, we obtained a correlation of .269, with a sign result of .252. Meanwhile, in the Paired Samples Test section, the results were 4.35165 in the Std section. Diviation, and Std. The mean error is .97306. Based on the results of this research, it can be seen between each question asked by researchers regarding the role of neurofeedback in the treatment of post-traumatic stress disorder: a neuro-psychological perspective.

DISCUSSION

Neurofeedback is a type of biofeedback that focuses on training brain activity (Müller et al., 2021). This allows people to learn to better control their brain activity by using technology that measures brain waves (Ashtiani et al., 2021). The history of neurofeedback is rooted in research in neurophysiology and psychology showing that feedback and training can change brain activity (Rajabi et al., 2020). Neurofeedback measures the brain's electrical activity through electrodes on the scalp (Lavy et al., 2019). Next, this activity is processed and displayed in a form that people can understand, usually via a computer screen. With repeated practice, a person can learn to change the way the brain functions, which can lead to better mental and emotional symptoms (Ma et al., 2021).

Neurofeedback can be used effectively in the treatment of PTSD, with a focus on the neuropsychological perspective (Groeneveld et al., 2019). Neurofeedback has been used in the mental health field to treat various disorders such as ADHD, anxiety,

depression, and especially PTSD (Domingos et al., 2021). Post-traumatic stress disorder, also known as PTSD, is a mental disorder that can appear after a person experiences or witnesses a traumatic event such as a natural disaster, serious accident, physical or sexual violence, or a war event (d'Ettorre et al., 2020). PTSD is characterized by a variety of symptoms that can greatly disrupt a person's daily life (Desmarais et al., 2020).

The main symptoms of PTSD include intrusive memories of the traumatic event (flashbacks), nightmares, severe anxiety, and excessive emotional and physical reactions when confronted with things reminiscent of the traumatic event (White et al., 2020). Trauma has a profound impact on the brain, causing lasting changes (Lebois et al., 2021). Research shows that trauma can change the structure and function of the brain, especially in areas related to memory and emotional processing (Comas-Díaz et al., 2019). The limbic system and prefrontal cortex are the two main areas most commonly affected by trauma (Anderson & Stevenson, 2019). The limbic system, consisting of the amygdala and hippocampus, is responsible for processing memory and emotions (Scherer & Voegtlin, 2020).

The neurofeedback process begins with an initial assessment to determine a person's brain activity patterns (Schumacher et al., 2020). This assessment usually involves an electroencephalogram (EEG), which measures the electrical activity of the brain in various areas (Nordli et al., 2019). Based on the results of this assessment, an appropriate neurofeedback protocol can be created (Van Son et al., 2020). Using this feedback, individuals are then trained to change their brain activity patterns (Xu et al., 2021). For example, people may be asked to focus and relax while observing changes in visual feedback if the goal of therapy is to reduce excessive beta activity (Y. Wang et al., 2019). Repeated practice can help the person learn to control their brain activity better (Yan et al., 2019).

The amygdala, in particular, is involved in fear and stress responses (Sorrentino et al., 2019). In people with PTSD, the amygdala tends to be overactive, leading to an exaggerated fear response (Orem et al., 2019). Meanwhile, the hippocampus, which is responsible for memory formation, is often shrunk in individuals with PTSD, which can lead to difficulty processing and remembering traumatic events (Lenane et al., 2019). The basic principle of neurofeedback is that the brain can be trained to change its activity patterns through repeated feedback (Sukhodolsky et al., 2020). This process involves measuring brain waves, which are then converted into audio or visual signals that people can understand. With repeated practice, people can learn to change their brain activity patterns in a direction that is better for their health.

Neurofeedback has been used to treat PTSD (Sho'ouri et al., 2019). Case studies show that neurofeedback can improve PTSD symptoms, such as decreased anxiety, increased emotional control, and decreased flashbacks and nightmares (Sho'ouri et al., 2020). Patients who do not respond to conventional therapy or seek alternatives are often candidates for neurofeedback therapy (Bioulac et al., 2019). Clinical assessment and compliance with neurofeedback protocols are usually the primary factors in

selecting patients for neurofeedback therapy (Ros et al., 2020). In neurofeedback, there are several types of brain waves: delta, theta, alpha, beta, and gamma (Hou et al., 2021). Each of these types of waves has a different frequency and is associated with different mental and emotional functions. For example, slower delta waves are associated with concentration and mental activity.

CONCLUSION

Neurofeedback has great potential as a treatment method for posttraumatic stress disorder (PTSD). It can help individuals change brain wave patterns associated with PTSD symptoms, such as anxiety, flashbacks, and nightmares, by measuring and training brain activity. Empirical studies show that neurofeedback can significantly improve PTSD symptoms, especially in individuals who do not respond to conventional therapy. Therefore, neurofeedback offers a new, non-invasive way to address the long-term effects of trauma. The neurobiological basis of PTSD suggests that trauma causes structural and functional changes in the brain, especially in areas such as the amygdala, hippocampus, and prefrontal cortex.

These changes can lead to exaggerated fear responses, difficulty processing and remembering traumatic events, and problems controlling emotions. Neurofeedback allows people to train and change unhealthy brain activity by providing direct feedback about brain activity. Thus, neurofeedback can help restore brain function disrupted by trauma. It takes special equipment and trained technicians to apply clinical neurofeedback in the treatment of PTSD. Neurofeedback, on the other hand, can provide significant benefits when used properly. Neurofeedback methods tailored to each person can improve therapy results and speed recovery. Many patients report improvements in emotional control, reduced PTSD symptoms, and improved overall quality of life, although results may vary between individuals.

Additionally, treatment outcomes can be improved by combining neurofeedback with other therapies, such as pharmacological therapy and cognitive-behavioral therapy (CBT). This combination allows patients to utilize a variety of methods to address their symptoms more holistically and comprehensively. Studies show that this multimodal method can produce greater and more sustained improvements in the treatment of PTSD symptoms.

Overall, neurofeedback is a promising tool for the treatment of PTSD from a neuropsychological point of view. With research and technology continuing to develop, neurofeedback can be an important component of a holistic approach to treating post-traumatic stress disorder. To support the current findings and improve treatment protocols, more rigorous designs and larger samples are needed additional research.

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