

# Compiling the Green Therapy Training Package and its Effectiveness on the Function of Frontal Part and Mirror Neurons in Hyperactive Children

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## ABSTRACT

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This study investigated the green therapy training package and its effectiveness on the function of the frontal part and mirror neurons in hyperactive children. A quasi-experimental study was conducted with a pre-test and post-test design for this purpose. This study's statistical population included all hyperactive students aged 7-9 living in Tehran in 2021-2022. This study's objectives indicated that the sample was 31 children diagnosed with hyperactivity by the Connors test, who were selected by the available sampling method and randomly divided into two experimental (15) and control (16) groups. Also, children received the intervention for nine sessions of 60 minutes (2 sessions per week) and the experimental group parents were trained. The data were analyzed using MANCOVA analysis, and the results showed that green therapy training has a significant effect on the function of frontal and mirror neurons.

### Keywords:

Frontal,  
Green therapy,  
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## Introduction

Hyperactivity is the most common behavioral disorder in childhood and adolescence; about 3% to 5% of children develop it before age seven. This complication occurs mainly during elementary school for children and puberty, and many patients get better with growing. The cause of most hyperactivity disorders is still unclear but it is considered a multifactorial disease with genetic and environmental roots. There is a definite reason for brain trauma and infection (Thapar et al., 2016).

Attention-deficit-hyperactivity disorder is a developmental-behavioral disorder. The child usually cannot pay attention and focus on a subject, has slow learning, and unusually high physical activity. This disorder is associated with inattention, hyperactivity, impulsive behaviors, or a combination. Many of these children have one or more other behavioral disorders. They may also have mental health problems such as depression or bipolar disorder (Millichap, 2011). These people's primary characteristics are lack of attention, for example, disorganization and forgetfulness about homework or work, and hyperactivity and impulsivity. These shortcomings can significantly disturb social relations (Barlow, 1942).

This disease has three symptoms: lack of attention (inattention), hyperactivity, and behaviors with the primary motivation performed without prior thought. The child's behavior is usually accompanied by hyperactivity, inattention, and impulsive behaviors. These behaviors include doing things half-heartedly, lacking mental effort to do homework, high physical activity and mobility even when not playing, losing personal belongings, and lacking concentration and high precision. We may have learning disorders during school, especially reading and writing disorders. These children usually get better with growth. Recovery before the age of twelve seems impossible, but the majority of cases with this disorder recover between the ages of twelve and twenty. The symptoms remain until adulthood in fifteen to twenty percent of cases. People with this disorder in adulthood do not have symptoms related to hyperactivity but are more restless, act impulsively and show attention and concentration disorders.

This disorder's leading causes include genetic factors, personality or temperament, factors before and after birth, brain structure and chemical composition, abnormalities of thyroid glands, low function of dopamine and possibly norepinephrine and epinephrine, and low blood serotonin levels, nutrition, and environmental factors (Barclay, 2015).

Hyperactivity affects a child's ability to pay attention or sit in school and have relationships with family and

other children. (Barbarasi et al., 2013). The family is a natural organization that uses various communication and functional patterns over time. These patterns form the family structure determine the role of family members, specify each member's scope, and facilitate the exchange of opinions between members. The family must have an efficient and healthy structure and function to better perform the family's primary duties (Bahari & Sia, 2005).

Parents can play a significant role in implementing behavioral interventions in the natural environment of the child's life due to their influence and more contact with children. Psychologists, psychiatrists, and education experts have tried to treat this disorder in different ways due to the problems and negative consequences caused by this disorder, such as aggression, manipulation of objects, risky behaviors, academic failure, and inadequate academic performance (Weinstein & Wiseman, 2012). According to some studies, the family's functioning is one of the factors affecting the development and spread of children's behavioral problems (Porsina et al., 2014).

Medication is a tool for ADHD, not a cure. Many people equate ADHD treatment with medication. It is essential to accept that ADHD medication does not work for everyone and does not solve all problems or eliminate symptoms. Although ADHD medication often improves attention and concentration, it usually does not help much with symptoms of disorganization, poor time management, forgetfulness, and tardiness which are the most problematic issues for people with ADHD (Weiser et al., 2014).

Everyone's response to ADHD medications is different. Common side effects of stimulants include loss of appetite, abdominal pain, headaches, and sleep disturbances. Some people experience significant improvement, but others experience little or no relief. The side effects also vary from person to person. In some cases, the side effects are more than the benefits. Alternative treatment has been suggested due to the side effects of drugs and the parents' concern regarding drug use, including simple lifestyle changes relying on parental support (Barbarasi et al., 2017).

There are various programs to reduce the symptoms of hyperactivity. Nowadays, green therapy is considered one of the best treatments for hyperactivity. This treatment depends heavily on the parents' support and aims to reduce symptoms by referring to parenting and changing the child's lifestyle. These changes can encourage children to focus their movements through organized activities such as rhythmic movements and rule-based games. Better concentration can also reduce anxiety and depression and be a great way to burn off

some extra energy that can help improve your child's sleep.

Regular and nutritious meals are suitable for everyone; nutrition can affect mood and mental state. Therefore, it is essential to set a specific time for eating natural foods and supplements that help with anxiety and ensure that those meals and snacks are nutritious (Thomas, 2020). It is possible to get relaxed by repeating activities (going outside and in nature, watching the sun, and doing exercise as ADHD prevention factors), limiting the time kids spend on online media, developing positive family relationships, empowering children in school, and teaching parenting and its principles, especially regarding the techniques of dealing with hyperactive children such as how to communicate, music and mental exercise (Simonov et al., 2014).

Several signs and symptoms show that the specific neural networks of music processing in the brain work independently and separately (independent of other brain neural structures). Strengthening and facilitating the functioning of the networks involved in music in the left hemisphere (through early music training) increases the mental ability related to these areas, which include the components needed by the mind for reasoning (Karimi et al., 2011).

Moreover, Cook et al. (2004) believed that story therapy can be helpful for children's cognitive-behavioral therapy. Attention- Deficit- Hyperactivity Disorder and related cognitive problems cause many disruptions in children's daily life, affecting the child and the home, school, and society. Like children's cognitive-behavioral treatments, story therapy techniques can be used effectively for them. Stories in story therapy can be considered an essential source in changing and improving children's problems and disorders by providing opportunities for emotional release and identification and raising the child's understanding (Crawford et al, 2017; Friedberg &Wilt, 2010). Homayi et al. (2007) investigated storytelling's effect on children's adaptation development. The results showed that storytelling is effective in increasing children's adaptability. Maleka (2010) conducted a study investigating how combining stories with group therapy can increase self-concept, create confidence, find a goal, have fun, increase problem-solving skills, and reduce children's loneliness.

On the other hand, the frontal lobe is one of the brain parts structure involved in hyperactivity, which is located in the front of the brain and makes up 20% of the neocortex, which includes three motor, premotor, and prefrontal parts. The motor cortex is responsible for making movements. The premotor cortex selects the movements, and the prefrontal cortex controls the

cognitive processes to choose the right movements at the right time and place. This choice is made by internalized information or controlled by external cues or in response to context or self-information. Damage in this brain area impairs a person's ability to perform various movement sequences, learn, memorize (Goni Klip, 2005), obey the law, and speak (Pour Ahmed, 2016).

Neuropsychology is one of the interventions in the field of education helping children and adolescents with hyperactivity disorder to increase the functions of the frontal lobe, reduce mental disorders and empathy and foster critical thinking. It is usually done by using the phenomenon of mirror neurons in the brain. Recent advances in neuroscience have led to the discovery of new neurons in the monkey brain called mirror neurons (Small, 2017). Giacomo Morizzolati, Vittorio Galsi and Leonardo Fogassi at the University of Italy discovered mirror neurons in the motor part of the macaque monkey brain for the first time. These motor neurons have extraordinary and unique properties in humans that are not found in monkeys (Ritsolati, 2005). Fadiga conducted the first research on humans in this field. He showed that when people observe another person's action, the mirror neurons are activated, and the frequency of movement potentials significantly increases in the muscle of the same part of the body that is observing another person's movement so that the person himself performs the observed action. The observation activates the same movement pattern in the observer as exists in the operator.

An interneuron system is a group of cortical motor neurons of the brain that creates involuntary visual-motor and auditory coordination between the observant brain and the operator of physical activity. Their connection with motor nerves forms an observation-motor network. These neurons are activated both during the person's own performance and when observing other people's sensory-motor actions (Ritsolati, 2005) and even when hearing different stimuli (Yoshida et al., 2012). Therefore, they are the primary mechanism responsible for the occurrence of observational learning. This system is also fundamental to understanding emotions, especially empathy and social interactions. The mirror mechanism is the only evidence by which the brain understands the actions and intentions of others, and in this case, emotions and feelings are valid. Rapid understanding of emotions and others' excitements with an emotional neuron system is necessary for empathy, which is the basis of most interpersonal communication. Emotions are essential in decision-making, and mirror neurons facilitate emotion processing. This system is part of a broad network that affects the goal-directed behavior of emotional processing (Kim et al. , 2016).

The mirror neurons' mechanism is activated only by stimuli that a person chooses and pays attention to (Ritsolati & Zinigalia 2010). Researchers believe that mirror cells are a means to explain different dimensions of the ability to understand actions, read minds, establish social recognition, and communicate with others. They can also understand what the operator is doing and imitate through body language and speech (Hayes, 2010).

Considering the above literature, this study intended to see whether 'green therapy' can affect the frontal part and mirror neurons in hyperactive children.

## Method

### Design

The current research adopted a quasi-experimental design with pre-test - post-test and a control group. The independent variables are green therapy training, and the dependent variables are frontal and mirror neuron function, conducted using a fever test and recording brain signals.

### Participants

30 hyperactive children with the age range of 7-9 were selected through available sampling living in Tehran. Then, they were randomly placed in the experimental and control groups with 15 participants in each.

### Instruments

The Connors parent test and a teacher questionnaire was used to identify children with attention deficit disorder and measure them through a fever test and wave recording.

### Procedure

The current research used a quasi-experimental design with pre-test and post-test. First, children with attention deficit disorder were identified and clinically observed through the Connors questionnaire, filled by their parents. Then, the researcher-made questionnaire was presented to the parents to gather data about the children in terms of family, birth status, physical condition, language, and music education history. The current study also recorded brain signals from the F3-F4 frontal region and investigated and measured mu and alpha signals in 7 to 14 Hz.

**Table 1.**

*Study Sessions*

Parent meetings	Education
<b>First session</b>	Acquaintance and introduction meeting in a group with families
<b>Second session</b>	Discussing hyperactivity symptoms and their problems
<b>Third session</b>	Checking progress and problems related to homework Essay on time management steps Distribution of daily activities planning worksheet
<b>Fourth session</b>	A review of the previous sessions and explanations about sports
<b>Child meetings</b>	Education
<b>First session</b>	Self-awareness training + personal values (to apply selective attention)
<b>Second session</b>	Practicing the previous session Reading the story, the group members in turns, presenting pictures and talking about the theme of the story with semi-organized questions
<b>Third session</b>	Practicing previous sessions Attention to excitements Net training
<b>Fourth session</b>	Practicing previous sessions Attention to excitements Net training
<b>Fifth meeting</b>	Situational emotion training
<b>Sixth session</b>	Listening to the music Teaching how to have interpersonal relationships
<b>Seventh session</b>	Listening to music and performing rhythmic movements
<b>Eighth session</b>	Playing a song with accompaniment Problem-solving training
<b>Ninth session</b>	Listening to the music Writing a group story of relationships and emotions

## Findings

### Brain Wave Results

**Table 2.**

*Examining the Marginal Mean between the Two Experimental and Control Groups*

Variable	Marginal average Experimental groups	Control groups
Theta F3waves	37723.	193.23
Theta F4 waves	*101 .20	713.25
Alpha F3 waves	*548 .12	089.16
Alpha F4waves	*081 .11	609.15
Beta F3waves	942.10	173.10
Beta F4 waves	884.10	345.9

Note: The sign \* indicates the significance of the marginal average difference between the groups

The results showed that green therapy intervention has improved subjects' scores in theta F4 waves, alpha F3 waves, and alpha F4 waves.

**Table 3.**

*MANCOVA Test to Investigate the Effect of the Intervention on Brain Waves*

The dependent variable	sum of squares	Degrees of freedom	Average Squares	F value	The significance level	Effect size	Test power
Theta F3 waves	0.225	1	0.225	0.021	0.887	0.001	0.052
Theta F4waves	208.841	1	208.841	34.194	0.001	0.598	1.000
Alpha F3waves	83.139	1	83.139	22.589	0.001	0.495	0.995
Alpha F4waves	135.937	1	135.937	42.957	0.001	0.651	1.000
Beta F3waves	3.917	1	3.917	0.645	0.430	0.027	0.120
Beta F4 waves	15.702	1	15.702	2.458	0.131	0.097	0.324

001. < 0p182 و . = 8 F268 و 0. = Wilks Lambda

The results of Wilks's lambda test (multivariate effect) showed that Wilks's lambda is equal to 0.268 and the F value is equal to 8.182, which is significant at the level of 0.01. This shows that the intervention significantly affected at least one of the dependent variables (theta F4 waves, alpha F3 waves, and alpha F4 waves). The covariance analysis to investigate the intervention's effect on brain waves showed that the intervention of green therapy was effective on three components out of the total of 6 components of brain waves (p<0.05).

## Discussion

There are various programs to reduce the symptoms of hyperactivity, among which green therapy is one of the best treatments for hyperactivity. This treatment relies heavily on the parents' support and aims to reduce symptoms by referring to parenting and changing the child's lifestyle. In this case, the therapeutic method

based on the child-parent relationship is the appropriate and effective psychological intervention to reduce the symptoms of attention-deficit/hyperactivity disorder in children with this disorder. Comprehensive child-parent training programs have provided a suitable opportunity for parents to understand and recognize attention-deficit/hyperactivity disorder and teach them to use communication, behavioral and emotional skills with children (Gerney & Ryan, 2013).

Increasing empathy and cultivating critical thinking, and using the science of neuropsychology is among interventions in the field of education and help children and adolescents with hyperactivity disorder to increase the functions of the frontal lobe and reduce mental disorders, which is done by using the phenomenon of mirror neurons in the brain. Recent advances in neuroscience have led to the discovery of new neurons in the monkey brain called mirror neurons (Esmal et al., 2017). This research measured the effectiveness of the green package in hyperactive children clinically and

through brain recording using the observational learning method. The findings showed an increase in alpha in the right and left frontal regions, which is consistent with the findings of Rizolati et al. (2005). Observational learning and green therapy training seem to be effective in children with symptoms of hyperactivity showing that humans make sounds through interneurons and decode indirect target movements (Rizzolatti et al., 1995). The results are consistent with those of the research conducted at the University of Parma in Italy. The research found that neurons control the motor functions of monkeys while grabbing or manipulating food, witness the activity of neurons that fire when observing the movement of others, and mirror neurons show how the brain decodes another animal's behavior, thereby facilitating that action. Using computer imaging techniques instead of recording single cells, researchers showed that humans also have a system of mirror neurons, although it is more complicated than a monkey grasping food (Manthey et al., 2003; Montgomery et al., 2007).

In this study, green therapy was based on parenting and accompanying parents. These findings were consistent with those reported by Domov and Naik (2018) who studied the effect of interventions based on positive parent-child interaction on the occurrence and persistence of children's behavioral and nutritional problems. Also, Loren (2018) studied the significant role of positive parent-child interaction in improving vulnerable children's clinical and psychological symptoms. The findings are also in line with those of Rezaei et al. (2016) examining the effectiveness of positive parenting group training on parents' stress and self-efficacy and students' behavioral problems. In sum, it can be concluded that observational learning and green therapy training are effective in children with hyperactivity symptoms.

### Conflicts of Interest

No conflicts of interest declared.

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