

Application Research of Art Environment Simulation Based on Virtual Reality Technology in the Treatment of ADHD

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Abstract: ADHD, a common neurodevelopmental disorder, affects the quality of life of many children and adults. Traditional treatments have limitations, so there is a need to seek new avenues of treatment. This study explores the application of virtual reality-based art environment simulation in the treatment of ADHD. This article presents successful examples of virtual reality technology in the medical field and combine it with the emotional regulation and cognitive impact of art environments. By developing a virtual art environment, this article aims to provide an innovative treatment modality for ADHD patients to help them improve their symptoms and enhance their quality of life. In the experiment, ADHD patients participated in a virtual art environment simulation treatment and the treatment effects were assessed through quantitative and qualitative data collection. The results of the experiment showed that the treatment conducted in the virtual environment had a positive impact on the reduction of ADHD symptoms, and an improvement in emotional state was also observed. These findings suggest that art environment simulation based on virtual reality technology may be a useful addition to the field of ADHD treatment, providing an innovative and effective treatment option for patients.

Keywords: ADHD, Virtual Reality Technology, Artistic Environmental Simulation, Therapeutic Innovation, Emotional Regulation, Virtual Environmental Experience, Symptom Improvement

1. Introduction

ADHD, full name Attention Deficit Hyperactivity Disorder (ADHD), is a common neurodevelopmental disorder in children and adolescents that may also persist into adulthood. The symptom cluster is characterized by inattention, hyperactivity, and impulsive behaviors that have a significant impact on the academic, social, and emotional well-being of the individual. ADHD is a complex neurobiological disorder whose exact etiology is not fully understood, but genetic, environmental, and neurobiological factors are all thought to be potentially relevant to its pathogenesis.

The pathogenesis of ADHD is a complex area involving multiple factors. Genetic factors play an important role in the development of ADHD. It has been found that the clustering of ADHD in families is quite significant, with a higher risk of the disease among relatives. Multiple genes have been associated with the development of ADHD, and these genes may be involved in processes such as synthesis, release and reuptake of neurotransmitters, which affect the normal functioning of neurons in the brain (Bashiri et al., 2017).

Neurobiological studies have revealed changes in brain structure and function in people with ADHD. Brain imaging studies have revealed structural and functional

abnormalities in the prefrontal cortex, striatum, cerebellum, and amygdala in patients with ADHD (Goharinejad et al., 2022). These regions are closely associated with cognitive functions such as executive attention, inhibition of impulses, and emotion regulation. Imbalances in neurotransmitters (such as dopamine and norepinephrine) are also thought to be a factor in the development of ADHD.

Symptoms that characterize ADHD primarily include inattention, hyperactivity, and impulsive behavior. These symptoms may manifest in different contexts and at different ages, but in most cases they can have a significant distress and impact on an individual's daily life.

Inattention: Individuals with ADHD usually have difficulty focusing on tasks or activities, are easily distracted, forget details, miss important information, and often have difficulty completing assignments or tasks, as shown in Figure 1. This can affect their performance in school, at home and in social situations.



Fig. 1. ADHD Masking

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Hyperactive Behavior: Individuals exhibit excessive physical activity, are unable to remain quiet, and frequently jump, wiggle their arms and legs, and so on. They seem to be constantly energized and have trouble stopping moving (Wang & Reid, 2011). This hyperactive behavior may interfere with learning and social activities and may cause discomfort to others.

Impulsive Behavior: Individuals with ADHD often exhibit impulsive behavior and lack adequate consideration of consequences. They may abruptly interrupt conversations, interrupt, or express emotions in inappropriate situations. This may affect their relationships with others.

It is important to emphasize that the severity of ADHD symptoms and the way in which they manifest vary from individual to individual. In some cases, attention deficit may be the main problem, while in others, hyperactivity and impulsivity symptoms may be more prominent. A definitive diagnosis of ADHD needs to be based on clinical assessment and standardized questionnaires, among other methods.

ADHD is a common and far-reaching neurodevelopmental disorder, and the etiology and pathogenesis behind it are still being explored in research. Genetics, changes in neurotransmitters, and abnormalities in brain structure and function may be involved in its development. Symptoms of ADHD include inattention, hyperactivity, and impulsive behavior, which may manifest differently in different contexts. Understanding the background and symptoms of ADHD is necessary to better recognize the disorder and provide assistance in its diagnosis and treatment (Schweitzer & Rizzo, 2022).

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder whose symptoms involve inattention, hyperactivity, and impulsive behavior. While a variety of treatments have been used to help people with ADHD manage their symptoms, there are still some limitations to these approaches.

Side effects: Medication is one of the common interventions for ADHD, but some medications can cause side effects such as insomnia, loss of appetite, and mood swings. These side effects may affect the patient's quality of life and require additional management.

Long-term effects: Although medications can reduce ADHD symptoms in the short term, the effects of long-term use still need to be studied in depth. Some studies have shown that symptoms may return after medication is discontinued and that tolerance may develop with long-term use (Fonseca et al., 2018).

Individual differences: Differences in how different patients respond to medications make it necessary to individualize medication. Finding the right medication and

dosage may take some time, and ongoing adjustments may be needed (Zangiacomi et al., 2022).

Time and patience: Behavioral therapies often require long periods of continued training and patience, which can be challenging for patients and families. Many families may face difficulties in maintaining a training program.

Consistency: Successful behavioral therapy requires a degree of consistency and discipline. This can be a challenge for individuals with ADHD who may have difficulty maintaining consistent attention and self-control.

Generalization: While behavioral therapies can make significant progress in training, generalizing these skills to real-life situations may face difficulties. There may be differences in how patients respond in the training environment and in their daily lives.

Inadequate Educational Support: Support for the special needs of individuals with ADHD in the school setting may be inadequate, which may affect their learning and adjustment.

Social difficulties: Individuals with ADHD may have difficulty socializing at school and may be misunderstood or isolated by their peers.

Inconsistent Academic Performance: The academic performance of individuals with ADHD may be inconsistent; they may excel in certain subjects or tasks, but may face challenges in others.

Complexity: Integrating multiple treatments into a comprehensive treatment requires the cooperation of a team of professionals, including physicians, psychotherapists, educators, and others. Coordinating different interventions may be difficult.

Family Support: Integrated treatment may require the active involvement and support of the family. However, this may be a challenge for some families, especially if time and resources are limited.

Although existing treatments can go some way to helping people with ADHD manage their symptoms, they still have a range of limitations. Medication may bring side effects and uncertainty about long-term effects, behavioral therapy requires time and patience, and the school environment may not be able to meet the specific needs of the patient. The complexity of integrated treatment and the need for family support may also pose challenges. Therefore, the search for innovative treatments and individualized intervention strategies is an important direction in the field of ADHD treatment to provide better support and improve patients' quality of life.

Virtual Reality (VR) technology is an innovative technology that allows users to interact with and integrate into a computer-generated three-dimensional simulation

environment. With the continuous advancement of technology, the application of virtual reality in the medical field is becoming more and more widespread, not only for clinical treatment, but also for rehabilitation training, surgical simulation, psychotherapy and many other fields (Guo et al., 2021).

Psychotherapy: Virtual reality technology has been widely used in psychotherapy, especially in the treatment of anxiety disorders, post-traumatic stress disorder and other psychological disorders. By creating realistic virtual environments, patients can face their fears and anxieties in controlled situations, thus enabling exposure therapy, as shown in Figure 2. This approach can help patients gradually adapt to what they fear and reduce their discomfort and fear.



Fig. 2. The VR application for ADHD treatment

Rehabilitation: The use of virtual reality technology in the field of rehabilitation is becoming more and more emphasized. Through customized virtual environments and interactive tasks, virtual reality can be used to help train patients with stroke, movement disorders and injuries in muscle coordination and motor recovery. Patients can simulate daily activities such as walking and grasping in virtual environments, thus improving their ability to take care of themselves.

Surgical Simulation: The use of virtual reality in medical education and surgical simulation is also becoming more common. Through virtual reality technology, medical students and surgeons can perform highly realistic surgical simulations, thus improving their skill level and surgical accuracy. This approach reduces the risks involved in actual surgeries while providing medical students with more hands-on opportunities (Wen et al., 2021).

The application of virtual reality in psychotherapy has achieved remarkable results, especially in the treatment of anxiety disorders and post-traumatic stress disorder. In social anxiety disorder, for example, patients may be afraid of interacting with others, which can limit their social activities. Virtual reality can create realistic social scenarios where patients can interact with avatars in a virtual environment. They can gradually adapt to the social scene and reduce their anxiety, thus improving their ability to interact with the real world.

In PTSD treatment, virtual reality can simulate scenes that trigger patients' traumatic memories, such as battle scenes and traffic accidents. Through repeated exposure to these scenarios, patients can gradually reduce their fear and sensitivity to traumatic memories, thus reducing symptoms.

The application of virtual reality in the field of rehabilitation has also made significant progress. For example, stroke rehabilitation patients may face problems with limb coordination and balance. Through virtual reality technology, patients can perform balance training and gait exercises that simulate daily activities such as climbing stairs and crossing the street (Kaimara et al., 2022). This type of training can facilitate the recovery of muscle coordination and balance.

Similarly, patients with muscular motor disorders can perform hand coordination and fine motor training through virtual reality. Customized virtual tasks can help them improve hand function and quality of life.

The application of virtual reality technology in the medical field brings new opportunities for clinical treatment, rehabilitation training, and medical education. It not only provides a more realistic experience, but also creates controlled environments for exposure therapy and skills training. Although encouraging results have been achieved in the application of virtual reality technology in the medical field, further research and practice are still needed to maximize its potential to provide better treatment and rehabilitation programs for patients.

As Virtual Reality (VR) technology continues to evolve, people are beginning to explore ways to combine art environment simulation with virtual reality technology to create more engaging and emotionally rich virtual experiences. Art environment simulation is the integration of visual, auditory and emotional elements into virtual reality to create a unique experiential space.

Virtual reality technology provides the ability to create a variety of virtual environments that can mimic the real world or be completely imaginary. Artistic environment simulation, on the other hand, emphasizes the creation of a unique experience through visual, sonic, and emotional elements designed to evoke emotions and perceptions in the viewer (Ogay et al., 2018). Combining the two creates a more immersive and emotionally rich experience in virtual reality, providing users with a deeper feeling and experience.

For people with ADHD, emotional regulation and perceptual experiences can be a challenge. The combination of artistic environmental simulation and virtual reality offers new possibilities for ADHD treatment. By creating virtual art environments that are emotionally rich, quiet, and beautiful, patients can relax, meditate, and

self-reflect in this special environment, which can help regulate emotions and anxiety. This art environment simulation not only creates a wonderful visual scene, but can also incorporate audio elements such as nature sounds and music to further enhance the emotional experience.

Benefits of art environment simulation and virtual reality in ADHD treatment:

Emotional Regulation: The combination of art environment simulation and virtual reality can provide a place for ADHD patients to regulate their emotions. In the wonderful virtual environment, patients can relax and reduce anxiety and tension.

Concentration: The unique nature of virtual reality environments can help people with ADHD focus their attention. By directing the patient's attention to the details and emotions of the virtual environment, they can be trained to better control their attention.

Emotional Experience: Artistic environmental simulations can create a rich emotional experience through visual, sound and emotional elements. This helps patients to feel and understand emotions more deeply, thus improving emotional awareness and emotion regulation.

Self-reflection: Virtual reality environments can provide a quiet, private space for patients to engage in self-reflection. The aesthetic elements of the art environment simulation can stimulate patients' imagination and prompt them to think about their inner world.

Innovative Treatment: The combination of art environment simulation and virtual reality brings an innovative approach to ADHD treatment. It can be used not only as a tool for emotional regulation, but also for training key skills such as attention and self-control.

The combination of art environment simulation and virtual reality brings new possibilities for ADHD treatment. By creating emotionally rich and beautiful virtual environments, patients can find space for emotional regulation and self-reflection in them. This innovative treatment not only improves the emotional state of ADHD patients, but also trains their attention and self-control. However, further research and practice are needed to gain insight into the effectiveness of artistic environmental simulation and virtual reality in ADHD treatment and to determine the best way to apply them in clinical practice.

In China, ADHD research has made significant progress in several areas, such as etiologic studies, clinical treatments, and intervention strategies.

Research on etiology and pathogenesis: Chinese researchers have conducted a great deal of exploration on the etiology and pathogenesis of ADHD. The influence of genetic and neurobiological factors as well as environmental factors on the development of ADHD is

gradually being recognized. Large-scale family studies and genetic association studies have provided strong evidence for the genetic mechanisms of ADHD.

Clinical treatment studies: Clinical studies in China have focused on medication and behavioral therapy for ADHD. Clinical trials have evaluated the efficacy and safety of different medications and the application of behavioral therapy in the management of ADHD. At the same time, the country is also exploring the effectiveness of integrated intervention methods such as Chinese medicine and psychotherapy.

VIRTUAL REALITY TECHNOLOGY AND ADHD: Virtual reality technology has also begun to gain attention in ADHD research and clinical practice in China. Some studies have explored the application of virtual reality technology in ADHD treatment, especially in attention training, emotion regulation and cognitive training.

Foreign contributions to ADHD research have also been remarkable, covering a wide range of areas from basic science to clinical practice.

Research on etiology and pathogenesis: Foreign research has made much progress in the study of the etiology of ADHD. Studies in genetics, neurobiology, brain structure and function have provided insight into the pathogenesis of ADHD.

Clinical treatment research: Foreign clinical research involves not only medication and behavioral therapy, but also psychotherapy, family intervention and other methods. Individualized treatment strategies, treatment continuity and long-term effects of the research has also attracted much attention.

Virtual reality technology and ADHD: In foreign countries, the application of virtual reality technology in the treatment of ADHD is also increasing. Virtual reality has been used in ADHD interventions to improve attention, self-regulation, and emotion management (Emmelkamp & Meyerbröcker, 2021).

Both at home and abroad, ADHD research continues to usher in new directions and challenges. Among them, the research on integrated treatment methods, such as combining virtual reality technology with art environment simulation to provide ADHD patients with a space for emotional regulation and emotional experience, is an innovative and worthwhile direction for in-depth exploration. However, issues such as standardization and consideration of individual differences in the clinical application of virtual reality technology still require further research. Overall, ADHD research at home and abroad provides opportunities for a deeper understanding and management of this disorder.

2. An Overview of ADHD Treatments

Medication is one of the most important methods of ADHD management, helping patients control their symptoms by adjusting the balance of neurotransmitters in the brain. The main types of medication include:

Stimulants: Stimulants are the most common ADHD medications and include Methylphenidate and Amphetamine. These medications improve the patient's attention and control by increasing the concentration of dopamine and norepinephrine, which raises neurotransmitter levels in the brain.

2.1. Medication

Non-stimulants: For some patients, stimulant medications may cause adverse reactions, making non-stimulants another option. For example, dihydroergotamine (Atomoxetine) is a selective norepinephrine reuptake inhibitor that improves attention and control by increasing norepinephrine concentrations, as shown in Figure 3.

ADHD Medication: Non-stimulants			
Class	Generic Name	Brand Name	Duration
SELECTIVE NOREPINEPHRINE REUPTAKE INHIBITOR	atomoxetine hydrochloride	Strattera®	24 hours
	viloxazino	Qelbree™	24 hours
ALPHA-2 ADRENERGIC AGONIST	clonidine hydrochloride	Kapvay®	12 to 24 hours
	guanfacine hydrochloride	Intuniv®	12 to 24 hours



Fig. 3. FDA-approved non-stimulant ADHD medication

Medication has shown some efficacy in patients with ADHD, but the effects vary from individual to individual. In general, medication can reduce ADHD symptoms by improving attention, concentration, and self-control. Stimulant medications usually have a quicker effect and can reduce symptoms in a short period of time. The effects of non-stimulant medications may take longer to manifest, but they may be a better option for some patients.

While medication is effective in reducing ADHD symptoms, it can be accompanied by a number of side effects. Common side effects include:

Insomnia: Stimulant medications may cause patients to have difficulty falling asleep at night, affecting the quality of their sleep.

Loss of appetite: Some medications may cause patients to lose their appetite, affecting normal dietary intake.

Mood swings: Individuals may experience mood swings and anxiety during medication.

Rapid heartbeat: Stimulant medications may cause a rapid heartbeat or arrhythmia.

Risk of Addiction: Stimulant medications may pose a risk of addiction and require close monitoring.

Since the effectiveness and side effects of medication vary from person to person, individualized treatment strategies are crucial. Doctors need to develop the most appropriate medication regimen based on patient-specific factors such as age, severity of symptoms, and family history. At the same time, monitoring and adjusting the drug dosage is also crucial to ensure the effectiveness of the treatment.

The persistence and long-term effects of medication are important considerations in the treatment of ADHD. Some studies have shown that medication can significantly reduce symptoms in the short term, but after discontinuation of medication, symptoms may recur in some patients. Therefore, long-term follow-up and evaluation are needed to ensure the persistence of treatment effects.

Medication, as one of the important methods of ADHD management, can improve patients' attention, concentration and self-control to a certain extent. However, the effects and side effects of medication vary from individual to individual, requiring individualized treatment strategies. In addition, the persistence and long-term effects of medication need to be given due attention. When formulating a treatment plan, physicians need to consider a variety of factors to ensure that patients receive the best possible outcome and quality of life.

2.2. Behavioral Therapy

Behavioral therapy is a non-pharmacological intervention widely used in the treatment of Attention Deficit Hyperactivity Disorder (ADHD). Compared with medication, behavioral therapy focuses on helping patients improve their attention, self-control, and social skills through education, training, and cognitive adjustments, thereby enhancing their quality of life.

Behavioral therapy encompasses a number of specific treatments designed to reduce ADHD symptoms by changing the patient's behavior and thinking patterns. Common types of behavioral therapy include:

Cognitive Behavioral Therapy (CBT): CBT focuses on helping patients recognize and change negative thinking and behavior patterns. In ADHD treatment, CBT can help patients identify and cope with impulsive behavior, inattention, and other problems.

Family Therapy: Family therapy emphasizes interaction and communication between family members. In ADHD treatment, family therapy can help family members understand the characteristics of ADHD and learn how to support and manage the patient.

Behavioral training: Behavioral training aims to develop good behavioral habits through positive reinforcement and rewards. This can include the creation of a reward system to encourage the patient to pay attention, complete tasks, and so on.

Social skills training: People with ADHD often face difficulties in socializing. Social skills training can help them learn appropriate social behaviors, communication skills, etc. to improve their social skills.

Behavioral therapies have been shown to be effective in the treatment of ADHD, especially in increasing self-control, improving social skills and learning behavioral regulation. The following are possible effects of behavioral therapy:

Improvement in Attention and Self-Control: Behavioral therapy can help patients improve their attention and self-control through training and feedback. This helps them better manage impulsive behavior and inattention.

Regulation of learning behaviors: Behavioral therapy can help patients develop appropriate learning strategies and time management skills, thus improving learning efficiency.

Improvement of social skills: Social skills training can help people with ADHD better understand others and improve their ability to communicate and get along with others.

Improvement of Family Relationships: Family therapy can improve the relationship between the patient and family members and enhance family support and understanding.

The persistence and long-term effects of behavioral therapy require the joint efforts of the patient and the family. Generally speaking, it may take some time for behavioral therapy to show significant results. In the meantime, patients and family members need to consistently apply the skills and strategies learned in their daily lives to maintain the efficacy of the therapy.

The effectiveness of behavioral therapy also varies from individual to individual, so individualized treatment strategies are also important. Therapists need to develop the most appropriate behavioral therapy program based on the patient's age, severity of symptoms, personal preferences, and other factors.

Behavioral therapy, one of the most important methods of ADHD treatment, helps patients improve their attention, self-control and social skills through education, training and cognitive adjustment. Different types of behavioral

therapies can produce different effects, so it is necessary to choose the appropriate treatment method according to the patient's characteristics. At the same time, the active participation of the patient and the family is key to maintaining the effectiveness of the treatment. The sustainability and long-term effects of behavioral therapy need to be verified by further research and practice.

Attention Deficit Hyperactivity Disorder (ADHD), as a common neurodevelopmental disorder, requires a comprehensive treatment approach to help patients reduce their symptoms and improve their quality of life. Currently, medication and behavioral therapy are the two main methods of ADHD treatment.

2.3. Advantages and problems of medication

Advantages:
Rapid Relief of Symptoms: Medication can usually significantly reduce the symptoms of ADHD patients, especially inattention and impulsive behavior, in a short period of time.

Widely used: Medication has been widely used for people with ADHD, and its efficacy has been proven in many cases.

Individualized Adjustment: Doctors can individualize treatment by choosing the most appropriate type of medication and dosage according to the patient's specific situation.

Research support: Many clinical trials and studies have demonstrated the effectiveness of medication in improving ADHD symptoms.

Problems:

Side effects: Medication may be accompanied by a range of side effects, such as insomnia, loss of appetite, and mood swings, which can affect the patient's quality of life.

Risk of addiction: Stimulant medications may carry a risk of addiction and require close monitoring of the patient's medication use.

SHORT-TERM EFFECTS: The effects of medication are usually short-term, and some patients may experience a relapse of symptoms after discontinuing the medication.

Not for all patients: Medication may not be appropriate for all patients with ADHD, especially those who are sensitive to medications or have other health problems.

2.4. Advantages and Problems of Behavioral Therapy

Advantages:

Comprehensive Interventions: Behavioral therapy emphasizes helping patients improve their ADHD symptoms through education, training, and cognitive modification, and encompasses multiple areas of intervention.

Long-term effects: The effects of behavioral therapy are usually long-term, helping patients establish good behavioral and cognitive habits and maintain the effects of treatment.

Wide range of applicability: Behavioral therapy can be applied to people of all ages with ADHD and is not affected by the physiological effects of medications.

Individualized treatment: Behavioral therapy can be individualized according to the patient's characteristics and needs.

Problems:

TIME AND PATIENCE REQUIRED: Behavioral therapy usually requires a certain amount of time and patience, and the patient and family need to actively apply the skills learned in their daily lives.

Effectiveness varies from person to person: The effectiveness of behavioral therapy varies from person to person. Some patients may see significant improvement while others may have limited results.

Family cooperation is needed: Family therapy and behavioral training may require the cooperation of family members, and the effectiveness of treatment may be compromised if family support is inadequate.

Not for severe symptoms: Behavioral therapies may not be appropriate for people with severe ADHD symptoms or may have limited effectiveness in specific cases.

An integrated treatment strategy combines medication and behavioral therapy to maximize the strengths of both approaches for better treatment results. Medication can provide quick relief of symptoms and help patients get better in the short term, while behavioral therapy can help patients establish lasting behavioral and cognitive habits and maintain long-term outcomes.

Integrated treatment strategies also face some challenges, such as the side effects of medications and the time-consuming nature of behavioral therapies. In addition, the selection, coordination, and adjustment of medications and behavioral therapies require the professional judgment of physicians to ensure that treatment effects are maximized while potential risks are reduced.

Existing approaches to ADHD treatment each have their own strengths and problems. Medication provides rapid symptomatic relief, but is accompanied by a range of side effects and short-term results. Behavioral therapy focuses on long-term results and individualized treatment, but requires time and active family involvement. An integrated treatment strategy can fully utilize the advantages of both approaches, but it also requires comprehensive consideration of the patient's characteristics and needs. When formulating a treatment plan, doctors need to work

closely with patients and their families to ensure that the most appropriate treatment method is selected to provide the best possible outcome.

2.5. Virtual Reality in Healthcare

Successful cases of virtual reality in psychotherapy

Virtual Reality (VR) is a digital technology that simulates a real environment, allowing users to interact with the virtual world through head-mounted displays, joysticks, haptic feedback, and other devices. In recent years, virtual reality technology has been widely used in the medical field, especially in the field of psychotherapy has shown great potential.

The application of virtual reality technology in psychotherapy has achieved remarkable results, especially in the treatment of ADHD patients, which provides a brand new way for innovative intervention. The following are some successful cases of virtual reality in psychotherapy:

1. **Virtual Reality Exposure Therapy (VRET):** VRET is a widely used treatment for psychological disorders such as anxiety disorders and post-traumatic stress disorder. Through virtual reality technology, patients can be exposed to their fearful situations in a controlled environment, which gradually reduces the level of fear. In ADHD treatment, VRET can help patients face impulsive behaviors and distracting situations, thus improving the ability of self-control and concentration.

2. **Virtual Reality Biofeedback Training:** Virtual Reality technology can be combined with biofeedback technology to help patients with ADHD better perceive and control their physiological state. For example, through virtual reality technology, patients can see their heart rate changes, so that they can learn to regulate their emotions and anxiety, and improve their emotional management skills.

3. **Virtual Reality Attention Training:** Inattention is one of the main symptoms of ADHD. Virtual reality technology can create a variety of tasks and situations to help patients focus and complete tasks. This kind of training helps to improve the cognitive control and stability of the patient's attention.

4. **Virtual Reality Social Skills Training:** People with ADHD often face social difficulties. Virtual Reality technology can simulate social situations and help patients practice interacting and communicating with others. This kind of training can improve patients' social skills and enhance their social adaptability.

The application of virtual reality technology in psychotherapy brings many advantages, especially in ADHD treatment with the following characteristics:

1. **Immersive experience:** Virtual reality technology can

create realistic virtual environments that make patients immersive. This immersive experience can help to stimulate emotions and improve treatment effects.

2. personalized treatment: virtual reality technology can adjust the content and difficulty of treatment according to the patient's needs and progress, realizing individualized treatment.

3. safety: virtual reality technology provides patients with the opportunity to practice in a controlled environment, reducing the possible risks of real life.

4. Improvement of treatment motivation: The innovative and interesting nature of virtual reality technology can stimulate the interest of patients and increase their motivation to participate in treatment.

5. Data collection and analysis: Virtual reality technology can record patients' behaviors and reactions, providing doctors with objective data support to adjust treatment plans.

Although the application of virtual reality technology in psychotherapy brings many advantages, it also faces some challenges:

1. Cost of technology: The high cost of equipment and software development for virtual reality technology may limit its wide application.

2. Adaptability issues: VRT may not be applicable to all ADHD patients, and some patients may not be comfortable with the technology or may have adverse reactions to it.

3. Validation of long-term effects: Although virtual reality technology has achieved some success in the short term, its long-term therapeutic effects need to be validated by more research.

4. Training of professionals: The use of virtual reality technology requires training of professionals to ensure proper operation and therapeutic effects.

5. Scope of therapeutic adaptation: The use of virtual reality technology in psychotherapy needs to be further explored to clarify its scope of adaptation in different psychological disorders.

The application of virtual reality technology in psychotherapy provides an innovative way to treat patients with ADHD. Through virtual reality technology, patients can face challenges in a controlled environment and improve their abilities in self-control, attention and social skills. However, the application of virtual reality technology also faces challenges such as technology cost, adaptability issues, and long-term effect validation. Considering its advantages and problems, virtual reality technology in ADHD treatment still needs further research and practice to better realize its potential..

2.6. Virtual Reality in Rehabilitation Training

The application of virtual reality technology in rehabilitation helps patients restore limb function, improve cognitive ability, and enhance quality of life by simulating various daily life situations.

Successful cases of virtual reality in rehabilitation training

1. Physical rehabilitation training: Virtual reality technology can simulate different movement situations in physical rehabilitation, helping patients to carry out fine and coordinated physical training. For example, among ADHD patients, some of them may have motor development problems, virtual reality technology can create interesting game environments to promote their development and rehabilitation through physical movement training.

2. Cognitive Rehabilitation Training: ADHD patients often face problems such as inattention and cognitive deficits, virtual reality technology can create different cognitive tasks to help patients improve their attention and cognitive ability. For example, through the tasks and challenges in the virtual world, patients can perform concentration, memory training, etc. to improve cognitive function.

3. Social skills training: Virtual reality technology can simulate social situations to help ADHD patients practice interaction and communication with others. By interacting with virtual characters, patients can enhance their social skills and improve their ability to interact with others.

4. Emotion management training: Virtual reality technology can create different emotion-triggering situations in a controlled environment to help patients learn to recognize and manage emotions. In ADHD patients, virtual reality technology can teach patients how to better handle emotions such as anxiety and impulsivity through situational simulation.

The application of virtual reality technology in rehabilitation training brings many advantages, especially in the rehabilitation of ADHD patients, with the following characteristics:

1. Creating rich contexts: Virtual reality technology can create a variety of rich contexts, simulating different scenes in daily life, helping patients better adapt to the real world.

2. Individualized rehabilitation: virtual reality technology can design individualized training programs according to the patient's rehabilitation needs, providing tailored rehabilitation experience.

3. Improve rehabilitation motivation: the fun and innovation of virtual reality technology can stimulate patients' interest in rehabilitation and increase their motivation to actively participate in rehabilitation training.

4. real-time feedback: virtual reality technology can provide real-time feedback information to help patients understand their own performance, so as to adjust the training strategy.

5. Reduce fear and pressure: virtual reality technology can be in a controlled environment for rehabilitation training, reducing the fear of patients facing the unknown and pressure.

The application of virtual reality technology in rehabilitation training also faces some challenges:

1. technology cost: the high cost of hardware and software of virtual reality technology may limit its wide application.

2. Adaptability issues: VR technology may not be applicable to all ADHD patients, especially those who are unfamiliar with the technology or have other health problems.

3. Lack of evidence of long-term efficacy: Although virtual reality technology has had some short-term success, more research is needed to validate its lasting effects in long-term rehabilitation.

4. Training of professionals: The use of virtual reality technology requires training of professionals to ensure proper operation and rehabilitation outcomes.

The use of virtual reality technology in rehabilitation training provides an innovative way to rehabilitate people with ADHD. By simulating various situations and tasks, virtual reality technology can help patients restore physical function, improve cognitive and social skills, and enhance their quality of life. However, the application of virtual reality technology also faces challenges such as technical costs, adaptability issues, and validation of long-term rehabilitation effects. Considering its advantages and problems, virtual reality technology still needs further research and practice in the rehabilitation training of ADHD patients to better utilize its potential.

Theoretical Foundations of Artistic Environmental Simulation and ADHD Treatment

Successful cases of virtual reality in psychotherapy

Art, as a medium for expressing emotions and thoughts, has a unique role in emotion regulation. In the treatment of ADHD, the enhancement of emotion regulation is an important goal, as ADHD patients often face problems such as mood swings, impulsivity and anxiety. Through a simulated art environment, patients can be provided with a platform for emotional expression and regulation, thus promoting the development of emotional management and self-control.

1. Art as a medium for emotional expression: Art can help patients with ADHD to express their emotions through painting, music, dance, etc., thus reducing emotional

suppression and impulsive episodes. Art works can be an outlet for patients' emotional catharsis, helping them to better understand and manage their emotions.

2. Emotion-regulating effect of art: Research shows that art can affect the emotion-regulating center of the brain, promoting the generation of positive emotions and reducing the impact of negative emotions. By creating and appreciating works of art, people with ADHD can learn to better regulate their emotions and increase their emotional stability.

3. The effect of art on anxiety and impulsivity: People with ADHD are often accompanied by symptoms of anxiety and impulsivity, and creating and experiencing art can reduce feelings of anxiety and impulsivity, and help patients achieve a calmer emotional state and better self-control..

2.7. Theoretical basis of ADHD treatment in art environment simulation

1. Perception-action cycle theory: Perception-action cycle theory believes that there is a close interaction between perception and action, and that art environment simulation can influence patients' emotional and behavioral responses by simulating perceptual experiences. For example, by creating beautiful natural scenery in a virtual reality environment, it can increase positive emotions and reduce anxiety.

2. Psychophysiological mechanisms: Art environment simulation can affect patients' neurophysiological mechanisms by triggering sensory pathways. Viewing art works or participating in art creation can activate the areas of the brain related to emotion regulation, promote the release of dopamine and other neurotransmitters, thus improving the patient's emotional state.

3. Perception-emotion-behavior model: The perception-emotion-behavior model suggests that perception has a direct effect on emotion and behavior. Artistic environmental simulation can change patients' perceptual experience, thus affecting their emotions and behaviors. By creating a relaxing and pleasurable environment in virtual reality, it can help ADHD patients reduce tension and impulsivity and enhance self-control.

Integrating art environment simulation with ADHD treatment can provide patients with training opportunities for emotional expression, emotional regulation and self-control. By creating or immersing themselves in works of art, people with ADHD can gain the following benefits:

1. Emotional catharsis and regulation: Artworks can be an outlet for ADHD patients to express their emotions, reduce anxiety, and gradually learn to manage their emotions more effectively.

2. Exercise of self-control: Through art environment simulation, patients can exercise self-control in an

emotionally calm state. They can experience calmness and patience in art creation, and thus apply this ability in daily life.

3. Enrichment of emotional experience: Art environment simulation can help patients enrich their emotional experience, enhance the production of positive emotions, and reduce the interference of negative emotions.

4. Acquisition of Meaning and Satisfaction: Art creation and appreciation can help people with ADHD gain a sense of accomplishment and satisfaction, thus improving self-esteem and self-confidence.

The influence of art on emotion regulation provides a theoretical basis for applying art environment simulation to ADHD treatment. By creating or experiencing artworks in virtual environments, people with ADHD can obtain training opportunities for emotional expression, emotional regulation, and self-control. Combining art environment simulation with therapy can provide patients with a more integrated and individualized therapeutic experience, thus promoting recovery and development. However, further research is needed to validate the practical effects of art environment simulation in ADHD treatment and to explore the best application and treatment options..

2.8. Fitting Artistic Environmental Simulation to the Characteristics of People with ADHD

ADHD is a neurodevelopmental disorder characterized by inattention, impulsivity, and hyperactivity. Individuals with ADHD often face school and socialization difficulties, emotional management issues, and challenges with self-control. To address these characteristics, treatment programs need to be targeted to help patients improve their self-control, attention, and emotion management skills. Art environment simulation, as an innovative therapeutic approach, has a good fit with the characteristics of ADHD patients and provides them with a unique therapeutic pathway.

Art environment simulation fits well with the characteristics of ADHD patients :

1. Creative expression and emotion management: People with ADHD often face problems in emotion management and have difficulty in expressing and regulating their emotions effectively. Art environment simulation can provide them with creative expression, through painting, music, dance and other forms of art, to help patients vent their emotions, relieve pressure, and gradually improve emotional regulation.

2. Immersive experience and attention training: ADHD patients often have difficulty concentrating and are easily disturbed by the outside world. The immersive experience feature of virtual reality technology can help patients focus their attention and reduce distraction. In the art

environment simulation, patients can devote themselves to art creation, thus improving the stability of attention.

3. Self-control and Situation Simulation: Art environment simulation can create various situations to help ADHD patients practice self-control in the virtual environment. They can face impulses and challenges in simulated situations and learn to better cope with and control their behaviors.

4. Emotional experience and emotion regulation: Appreciation and creation of art works can promote the generation of positive emotions and alleviate the impact of negative emotions in people with ADHD. Art environments in virtual reality can create pleasant and relaxing emotional experiences, helping patients better regulate their emotions.

Application of art environment simulation in ADHD treatment :

1. Art creation therapy: ADHD patients often lack self-confidence and sense of achievement, and art creation can help them experience success and fulfillment. In the virtual art creation environment, patients can try painting, sculpture and other creations, from which they can gain fun and confidence and improve self-esteem.

2. Art experience impulse control: Art environment simulation can help patients with impulse control training in impulse-prone situations. For example, in the process of art creation, patients need patience and concentration, so as to exercise self-control.

3. Emotional regulation in art situations: In virtual art situations, patients can experience different emotional experiences, from pleasure to contemplation, from relaxation to excitement. This kind of emotional experience can help ADHD patients better recognize and regulate their emotions, thus improving their emotion management ability.

2.9. Explanation of potential therapeutic mechanisms

ADHD is a complex neurodevelopmental disorder whose treatment requires a combination of different factors and mechanisms. The application of virtual reality technology and art environment simulation in the treatment of ADHD may involve a range of potential therapeutic mechanisms that interact with each other to provide multiple levels of support and assistance for the rehabilitation of ADHD patients.

Sensory experience and neuromodulation mechanisms: Virtual reality technology provides rich sensory experience by simulating real environments, which has a positive impact on the neuromodulation of ADHD patients. People with ADHD are often oversensitive to external stimuli and are easily disturbed. Artistic environment simulation can

create interesting and attractive situations to help patients focus on the virtual environment and reduce external disturbances. Through the regulation of sensory experience, ADHD patients can better control their attention and improve their ability of self-control.

Creative Expression and Emotion Regulation Mechanism: Art creation is a kind of creative expression, which can help ADHD patients better express their inner emotions and relieve anxiety and emotional instability. The art environment simulation in virtual reality technology provides a safe space for patients to express their emotions, and they can express their emotions through painting, music and other ways, thus reducing their inner pressure. Creative expression not only helps emotional catharsis, but also develops patients' ability to generate positive emotions and emotional regulation.

Self-control and cognitive training mechanism: ADHD patients often face difficulties in self-control and are prone to impulsive and display overactive behaviors. Art environment simulation in virtual reality technology can help patients train self-control by creating virtual situations. For example, during the process of art creation, patients need to pay constant attention to details and goals, which helps them exercise their self-control and concentration skills. At the same time, art environment simulation can also create a variety of situations to help patients better cope with challenges and impulses, thus improving their level of self-control.

Emotional Experience and Positive Emotional Mechanisms: Artistic environmental simulation can create a variety of emotional experiences ranging from pleasure to tranquility, from relaxation to excitement. These emotional experiences can promote positive emotions and mitigate the effects of negative emotions in people with ADHD. Artistic situations in virtual reality can provide a relaxing space for patients, thus reducing anxiety and tension. The enhancement of positive emotions can help improve the emotional state and socialization of patients with ADHD.

Perceptual-Cognitive-Emotional Model and Comprehensive Rehabilitation Mechanism: The perceptual-cognitive-emotional model emphasizes the interactions among perception, cognition, and emotion, and the application of virtual reality technology and art environment simulation in ADHD treatment is closely related to this model. By creating sensory stimulation and developing self-control and emotional regulation, people with ADHD can benefit from a comprehensive rehabilitation process. Artistic environmental simulation can build on this model to provide comprehensive rehabilitation training covering multiple aspects of the cognitive, affective, and behavioral domains.

3. Research Methods

In this study, in order to investigate the effectiveness of artistic environmental simulation in the treatment of ADHD, a virtual reality environment was developed with the aim of providing training opportunities for emotional expression, self-control, and emotion regulation. The development of the virtual reality environment covered the following steps:

1. **Goal identification:** This article first defined the goal of the virtual reality environment, which is to help ADHD patients express their emotions and improve their self-control and emotion management skills by simulating art scenes.
2. **Scene design:** According to the research objectives, this article designed several art scenes, including natural scenery, abstract painting, etc., in order to meet the different emotional expression and training needs of patients.
3. **Technology development:** This article developed the virtual environment with the help of virtual reality technology, utilizing virtual reality headsets, handles and other devices. Through 3D modeling and programming, this article realized the interactivity and emotional experience of the scene.
4. **User testing:** After the development of the virtual reality environment was completed, this article conducted several rounds of user testing to ensure the usability and realism of the environment. Based on user feedback, adjustments and optimizations were made.

In order to conduct this study, this article developed strict criteria for participant recruitment. Participants were required to fulfill the following criteria:

Age range between 18 and 30 years old.

Be clinically diagnosed with ADHD, meeting DSM-5 diagnostic criteria.

Not have a serious mental illness or cognitive impairment, and not have an allergy to virtual reality environments.

Experimental design: This study used a randomized controlled trial design in which participants were randomly divided into two groups: the experimental group and the control group. The experimental group participated in the art environment simulation treatment of the virtual reality environment, and the control group received the traditional behavioral therapy treatment.

Experimental Procedure: The experimental process was divided into three phases: pre-experimental, therapeutic intervention and post-test.

Pre-experimental phase: In this phase, this article conducted an initial assessment of participants, including

tests of attention, self-control, and emotion regulation, to ensure that the experimental and control groups were similar at baseline on these variables.

Treatment Intervention Phase: Participants in the experimental group will undergo an art environment simulation treatment in a virtual reality environment for 30 minutes twice a week for 8 weeks. Participants in the control group will receive traditional behavioral therapy at the same frequency and duration.

Post-test phase: At the end of the treatment, participants in the experimental and control groups will be reassessed to compare the two groups in terms of changes in attention, self-control, and emotion regulation.

Data collection: This article will use standardized questionnaires and test instruments, such as the ADHD Assessment Scale and the Emotion Regulation Questionnaire, to collect data from the participants. In addition, this article will record the activities and performance of the participants in the experimental group in the virtual reality environment.

The collected data will be statistically analyzed, including descriptive statistics, t-test, and ANOVA. This article will compare the changes in attention, self-control and emotion regulation between the experimental group and the control group to assess the effectiveness of art environment simulation in ADHD treatment. Also, this article will explore the effects of different participant characteristics on treatment effects.

In conducting the experiment, this article will strictly observe ethical principles to ensure that participants' rights and privacy are protected. Participants will sign an informed consent form before the experiment to understand the purpose, process and possible risks of the experiment. At the same time, this article will respect the voluntary nature of the participants and will not exert any undue pressure.

3.1. Experimental results and analysis

At the end of the virtual art environment simulation treatment, this article collected and analyzed quantitative data from the experimental group of ADHD patients to explore changes in attention, self-control, and emotion regulation.

1. **Attention changes:** Participants' attention was assessed using the ADHD Rating Scale, with higher total scores indicating more severe attention difficulties. In the experimental group of ADHD patients, participants' attention scores generally declined at the end of the virtual art environment simulation treatment. The results presented in Table 1 show that participants' initial scores decreased by an average of about 23% compared to their post-treatment scores, with the maximum decrease

reaching 28%. This result suggests that virtual art environment simulation therapy has a positive impact on improving attention problems in people with ADHD.

People with ADHD often face difficulties in focusing their attention and are easily distracted and impulsive. Virtual art environment simulation therapy provides them with an engaging context to help them focus better. During art creation and situational simulation, participants need to pay constant attention to details and task goals, which hones their attention span. This could be one of the reasons for the decrease in their attention scores.

Table 1. Attention Assessment Results

Participant No.	Initial rating	Post-treatment score	Percentage change
001	28	21	-25%
002	32	24	-25%
003	29	22	-24%
004	25	18	-28%
005	31	25	-19%

2. **Self-control changes:** Through behavioral observations and self-report questionnaires, this article assessed participants' self-control. The results of the self-control assessment presented in Table 2 show that the self-control scores of ADHD patients in the experimental group increased overall at the end of the treatment. On average, participants' self-control scores increased by approximately 19% after treatment, with a maximum increase of 25%. This result suggests that virtual art environment simulation therapy can help improve self-control in people with ADHD.

Table 2. Results of self-control assessment

Participant No.	Initial rating	Post-treatment score	Percentage change
001	15	18	+20%
002	16	20	+25%
003	14	17	+21%
004	17	20	+18%
005	19	22	+16%

Individuals with ADHD often exhibit impulsivity and behavioral hyperactivity and lack effective self-control. In the virtual art environment, participants were required to remain calm and self-restrained during creative and situational simulations, thus exercising their self-control.

In addition, the virtual environment provided a relatively safe space in which participants could gradually learn how to inhibit impulsive and inappropriate behaviors. This may be one of the reasons for their improved self-control scores.

In addition to quantitative data, this article also collected and analyzed qualitative data on mood states of the experimental group with ADHD. During the treatment period, this article conducted regular interviews and emotional surveys with the participants.

1. Increased pleasure: In the virtual art environment, many participants reported feeling pleasure and relaxation. They experienced positive emotions while creating and enjoying the artwork, which contributed to an elevated emotional state.

2. Decreased impulsivity: Participants reported that they could better control impulsive and hyperactive behaviors in the virtual art environment simulation. They learned to think calmly and exercise self-restraint in the contextual simulation.

3. Improved emotional regulation: By participating in the virtual art environment simulation, people with ADHD gradually learned to manage their emotions better. They were able to cope and regulate their emotions more effectively in the face of challenges and pressures.

4. Improved self-confidence: Participants had a successful experience in the virtual art environment simulation, which helped to improve their self-confidence and self-esteem. They gained a sense of satisfaction from creating art and developed a more positive view of their own abilities.

By analyzing the results of the attention and self-control assessments, this article can see the positive impact of virtual art environment simulation therapy on people with ADHD. This treatment provides patients with the opportunity to exercise attention and self-control through creative art activities and situational simulations. During the course of the treatment, patients gradually developed better ability to focus their attention and self-calming, which helped to improve their daily life and social interactions.

It should be noted that the sample size of this study is small and the results may be affected by individual differences and other factors. Future studies may consider enlarging the sample size and conducting more in-depth comparisons with a control group to further validate the effects of virtual art environment simulation therapy. In addition, this article need to gain a deeper understanding of the effects of virtual art environment simulation on emotional regulation, social skills, and other aspects to reveal its comprehensive effects.

4. Conclusion

The goal of this study was to explore the application of virtual reality technology-based art environment simulation in the treatment of ADHD. Through the combined use of virtual reality technology and art environments, our experimental results suggest that virtual art environment simulation therapy has the potential to improve ADHD symptoms and emotional states. This treatment not only provides a novel experience, but may also have positive effects in terms of emotion regulation and cognitive functioning. However, this article also recognizes the limitations of the current study, such as the relatively small sample size, and the need for further long-term studies to validate the persistence and long-term impact of the treatment effects. Future studies could further explore the mechanisms of virtual art environment simulation therapy, optimize the design of virtual environments, and their application in ADHD patients of different ages and symptom severity. Taken together, virtual reality-based art environment simulation brings new hope and possibilities to the field of ADHD treatment and provides a useful addition to the rehabilitation and quality of life of ADHD patients.

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Author contributions

Jun Dong: Conceptualization, Methodology, Software, Field study, responsible for writing the full text.

Kamal Sabran: Visualization, Investigation, Writing-Reviewing and Editing.

Conflicts of interest

The authors declare no conflicts of interest.

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