Original Research Article

The Application of AI Robots in Autism Spectrum Disorder Children

Xiaoxia Jiang[1,2], Yuedong Yang[1], Shaogeng Zeng[2,3,4,*], Xialing Huang[1], Yuting Zhao[1]

1. Lingnan Normal University School of Educational Science, Guangdong Zhanjiang, 524048

2. Guandong Provincial Key Laboratory of Development and Education for Special Needs Children, Guangdong Zhanjiang, 524048

3. Lingnan Normal University College of Computer and Intelligent Education, Guangdong Zhanjiang, 524048

4. Guangdong University Digital Learning Engineering Technology Development Center, Guangdong Zhanjiang, 524048

Abstract: With the continuous progress of artificial intelligence, artificial intelligence robots are more and more widely used in special education. This paper introduces the application research of artificial intelligence robots in the field of autism, from the types, advantages and application fields of artificial intelligence (diagnostic evaluation, social interaction skills, perception-motor). According to the difficulties faced by artificial intelligence robots in the field of autism, the following suggestions are put forward: the future application of artificial intelligence robots should follow strict evidence-based experimental standards; To establish a paradigm for the intervention of artificial intelligence social robots in the whole process of autism for reference; Improve the ability of AI social robots to meet the individual needs of autistic children.

Keywords: Autism Spectrum Disorder; AI Robot; Autism Diagnostic; Social Interaction, Perception Motor

Introduction

Artificial intelligence robot, as an emerging technology auxiliary technology, is effective in the diagnosis, social interaction, sensory and perceptual motion training of autistic children. AI robots have many advantages in the field of autism education and rehabilitation. Although artificial intelligence robots have the characteristics of various types and wide application fields, there are many challenges and difficulties in the application of artificial intelligence robots. The following will be divided on these key points.

1. Advantages of AI robots in autism assessment and intervention

First, Artificial intelligence robot design is novel, beautiful in appearance, easy to attract the attention of children with autism, increase children's participation in assessment, intervention, increase the positive learning experience of autistic children; Second, children with autism have the characteristics of pro inanimate objects, artificial intelligence robots, as an inanimate entity, it is easier to promote the interaction of autistic children with robots, simulate its movement and expression, or interact with intervenors as social media; Third, the AI robot has simple faces, usually with only the eyes and the mouth, the changes can be set artificially, its expression is more likely to be recognized by autistic children; Fourth, assessment, education, and rehabilitation of autism require substantial human and material resources, and requires a lot of repeated observation and recording work, this poses many challenges for autistic parents and professional interventionists. Artificial intelligence robots can just use their technological advantages to replace human resources for a large number of repetitive tasks, greatly reduce the intervention burden and human economic costs.

2. Type of AI robots used in autism

Artificial intelligence robots used in the field of autism can be roughly divided into two types: the first is a non-humanoid robot or a toy robot, which can be further divided into animal robots and other shaped robots according to their shape. Animal robots refer to robots in the shape of animals. The common animal robots are elephants, parrots and dinosaurs. For example, the elephant robot Probe is a green filled elephant with eye gaze and facial expressions, blink, flap ears, mouth, nod, shake head, and speaks in a real person recording. There are other toy robots that are also widely used in autism, such as Keepon and Pekoppa. The second kind of artificial intelligence robot is a humanoid robot. There are two kinds of humanoid robots: mechanical humanoid robot and simulated humanoid robot. Although mechanical humanoid robots have the basic structure of the human body, they are usually hard and generally short. The more widely used mechanical robot is Nao. Nao is a robot made by Aldebaran Robotics, and can walk, talk and dance. The robot is equipped with a camera, microphone, speakers and multiple sensors to capture information in the environment, as well as to identify speech and locate sound sources during the interaction. Light diodes spread throughout the body and eyes and can be used for non-verbal communication. The Nao robot can make both standard machine sounds and pre-recorded human sounds. When accompanying autistic children, Nao participates in activities in an attempt to improve their ability to read facial expressions and make proper eye contact. For example, ShanWuddin et al, using the Nao robot to train autistic children to gaze. The simulated humanoid

robot is made in accordance with the proportion and shape of the human body, with a realistic appearance, such as ACTROID-F, its appearance is an adult female, white skin, limbs and facial features and other human organs, and a variety of expression changes, can greet and ask questions.[1]

3. Application of AI robot in children with autism

3.1 Application of artificial intelligence robot in the diagnostic and evaluation of children with autism

The traditional autism diagnosis is determined by qualified experts who observe the clinical behavior of autistic children by using standardized tools. Autism diagnostic interview-revised, Autism Diagnostic Interview Scale (Revised edition) (ADI-R) and Autism Diagnostic Observation Scale (second edition) (autism diagnostic observation schedule, second edition, ADOS-2) are widely used internationally to make artificial diagnosis of autism.However, professionals need to undergo a lot of training before using standardized tools, and the Chinese versions of ADOS-2 and ADI-R have not been published, so they are still not directly used in clinical practice.Artificial intelligence robots can break the limitation of talent and use the training neural network model by analyzing the relevant data to assist in the diagnosis of autism. The data types can be divided into brain imaging-based studies and based on multimodal data on language, action and facial expressions.

3.2 Application of AI robots in cultivating social interaction skills for autistic children

The intervention of AI robots for social interaction skills in autistic children involves multiple areas of secondary ability, including expression recognition, eye contact, physical contact, common attention, imitation, sharing, verbal expression, and social collaboration skills. According to the classification of Zhang Xinxin, Wang Fang and Yang Guangxue, Common training methods of social interaction skills of artificial intelligence robots can be roughly classified as collaborative games, create a social situation, imitation games and the combination of robotics with other therapeutic techniques.

3.3 Application of AI robot in the field of perceptual movement for autistic children

The application of artificial intelligence robots in the field of children with autism focuses on body coordination and movement imitation ability. The more common approach is to combine music and dance movements so that autistic children and robots can improve motor skills and physical coordination in mutual imitation. In addition, some researchers will combine the training of motor skills with cognitive learning.

4. The dilemma facing the application of AI robots in the field of autism

The application of artificial intelligence robots in autism education and intervention also faces many challenges and dilemmas. First, the lack of more number of validation studies, especially experiments in applied studies, most of which are single subjects with small samples, and lack the precise selection of age, sex and ability characteristics of autistic subjects, and lack the collection and description of basic information of participants and autistic subjects. The existence of this phenomenon greatly affects the interpretation of the characteristics in autistic subjects. In addition, the existing research lacks the long-term effect tracking of AI robots, and whether the trained ability can be classified to the real ecological environment needs to be stronger evidence. Second, the previous research on the application of artificial intelligence robot intervention in autism focused on the specific application at the technical level, and failed to establish a comprehensive, easy to operate and clear paradigm. A process mode has not been formed for reference for the intervention process such as case settlement, diagnosis, adaptation, intervention and evaluation of artificial intelligence robot. Third, the ability of AI robots to meet personalized needs remains to be improved. The importance and necessity of artificial intelligence robots to improve the flexibility to adapt to the complex and changeable personality characteristics of autistic children and establish corresponding "matching" procedures with children is self-evident. Fourth, there is a lack of localization studies. In the past, a large number of literature are explored by foreign scholars, the domestic mainland is still in the initial stage, most theoretical quotations and foreign research introduction, reports, literature review, lack of application research of practical cases.[2]

5. Recommendations for future research.

With the increasing progress of auxiliary technology, the application research of artificial intelligence products in the education of autistic children should be continuously enriched, so as to promote the informatization and modernization level of special education.

Future application of robot artificial intelligence in the field of autism research should have the following innovative advantages: First, follow strict evidence-based experimental standards, strictly confirm the artificial intelligence social robot on autistic children's language ability have intervention effect, and experiment and tracking cycle is long, explore the intervention effect, the scope and boundaries.Second, it aims to establish a paradigm for the whole-process intervention for autism, and to report the intervention process including consultation, diagnosis, adaptation, intervention, and evaluation. At the same time, combined with the new international trends, increase the participation of parents and families, pay attention to ecological real situations, and empower autistic families. Third, improve the ability of artificial intelligence social robots to meet the personalized needs of autistic children, establish a scientific auxiliary device adaptation evaluation scheme, accurately discover the specific learning needs of children, and match the training content of autistic children through the adaptive system and deep learning system.

References:

[1] LU Xiaojie, TIAN Lin, ZHANG Jie, JING Wei. An Overview of the Comprehensive Intervention Model for Autism in the United States and Its Development Trend[J].Chinese Journal of Special Education. 2021, (10) : 44-51.

[2] Costescu, Cristina a. Vanderborght, Bram David, Daniel o. Beliefs, Emotions, and Behaviors - Differences Between Children With asd and Typically Developing Children. a Robot-enhanced Task [j] .Siam Journal on Applied Dynamical Systems. 2017,16(2) : 221-237.