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Artificial Intelligence (AI) in Autism

Angeliki Sideraki[1], Athanasios Drigas[2]

[1 2]N.C.S.R. "Demokritos"

angeside@helit.duth.gr[1], dr@iit.demokritos.gr[2]

Abstract. This paper examines the issue of artificial intelligence and its association with autism. More specifically, at a first level, reference is made to the concept of artificial intelligence, but also to concepts that are directly related and are an extension of it. In addition, the various areas in which the use of artificial intelligence is identified are presented, while the concept of autism and its connection to technology are also analyzed. As research progresses on artificial intelligence and the diagnosis of autism. More specifically, the role of artificial intelligence is now particularly active in diagnosing various disorders including autism. Innovative methods are involved in this process. The following is a summary of research that can help people diagnose autism more easily with the help of machine learning and other technologies. The presence of genetics plays a crucial role as through the identification of different genes of people with autism several conclusions have been drawn. Finally, there are some studies that have studied the role of artificial intelligence in the treatment and intervention of autism. These include robots with artificial intelligence, virtual reality (VR), chatbots, etc. and whether all of this is considered effective for the development and empowerment of children in areas with difficulties such as speech and socialization.

Keywords. Artificial intelligence, deep learning, education, special education, autism, emotion, tools, tests, intervention, algorithms, autism spectrum disorder, diagnosis, machine learning, genes, MRI, research, treatment, amplification

1. Introduction

It is undeniable that artificial intelligence has been of particular concern to the scientific community in recent years. One of the areas identified is education providing assistance with the use of various educational software. At the same time, it supports students who are faced with learning difficulties, but also autism. In addition, it can be understood how the teaching and learning process is affected, as it is easy to modify and turn the lesson into an interesting world of constant exploration and discovery for the whole student population and especially for children. with autism. It is worth noting that the successful combination of artificial intelligence and training can allow more time for activities where no digital technology is required. In addition, artificial intelligence complements and supports the work of teachers. It is important that it helps children to develop skills and acquire knowledge that they would otherwise have difficulty or not be able to acquire at all. Therefore, if artificial intelligence is used properly, it can be considered highly effective in empowering children and especially autistic children in learning, social and any other possible level.

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3. Metacognitive Processes & Consciousness. The cognitive processes of the human brain contribute to the organization and representation of knowledge. As the person evolves and their brain processes develop, this happens because of new experiences. Critical cognitive skills are working memory, attention, perception, visual and spatial processing and various executive skills and play. Cognitive skills should be considered as general tools for retrieving and managing the domain - especially knowledge. Researchers report a variety of elements of metacognition, such as memorization, monitoring, and the sense of knowledge. The development of cognition requires the training of cognitive skills, such as attention, short-term and working memory. The cognitive process plays an important role in the development of consciousness, as it helps the individual to develop from one level to another. To move from one layer to the next. We will examine the consciousness and the axis it supports. For this transition from one level to another there is the pyramid of knowledge. Cognition is the ability of individuals to know their cognitive functions, to regulate them and to monitor their progress. The purpose of this process is to optimize the adaptation to equivalent needs and requirements that arise during the entire learning process (Drigas, A. & Pappas, M. 2017).

8 Pillars X 8 Layers Model of Metacognition. Metacognition is a scientific field, which has attracted the interest of scientists, especially in the 21st century. Despite the extensive research that has taken place, an interdisciplinary model has not yet been proposed, on the basis of which it is possible to shed light on the issues that have arisen regarding the true nature of metacognitions and the methods that can be applied to develop metacognitive skills in the subjects. The aim of the study conducted by Drigas and Mitsea (2021) is to present a new, multilevel and interdisciplinary model which is based on established theories that have been extracted from various studies (psychological, natural sciences, environmental, cognitive, philosophical, etc. K.). The two researchers describe in detail the cognitive and metacognitive processes involved in each level of the model, while emphasizing the relationship that develops between control processes and attention (Drigas & Mitsea, 2021)

According to the proposed multilevel model, each layer of metacognition involves a specific control system of high order and functionality, which operates according to a series of procedures involving attention. The same is true with other cognitive processes. The higher the level, the more sophisticated features and functions are manifested that are perfectly in line with the subjects' need for the creation of abstract mental representations, higher-order thoughts and emotions. The eight layers of the eight pillars of metacognition are as follows: 1) Understand the sensory processing system. 2) Self-assessment of facilitators as well as inhibitors of sensory processing. 3) Regulation of physiological and sensory processes. 4) Adaptation of sensory processes. 5) Recognizing the stimuli, the different sensory characteristics as well as the changes in the visual field. 6) Distinguish between competing or similar stimuli. 7) Recall of sensory information and 8) mobilization of useful strategies. These levels are the same in all metacognitive processes (Drigas & Mitsea, 2021).

The aim of the familiar model of cognition is to enrich the research data regarding the way and the pace of evolution of cognition, with the ultimate aim to develop effective strategies that can be applied in the educational context (Drigas & Mitsea, 2021)

The main conclusion that emerged from the creation of the model by the two researchers is that special attention should be paid to the process of self-regulation, as it helps to move us from the lowest levels of existence to the highest. The value of self-observation is maximized over time. Through self-observation, subjects gain self-awareness (Drigas & Mitsea, 2021).

Of course, self-observation is a perpetual process. Philosophically, self-observation as a type of metacognition is equivalent to the process of remembering finite moments of consciousness, which are recalled in memory and through them individuals perceive more

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holistically the events that have occurred. Continuing, it should be mentioned that metacognition is an "open type" activity, ie each subject handles the metacognitive processes in his own way. More specifically, metacognitive processes expand as the observer deepens his or her description of his or her own cognitive system (Drigas & Mitsea, 2021).

By no means should we forget that the eight structured stages of cognition (using terms of consciousness) are interrelated and each is related to a kind of intelligence out of the eight proposed by Gardner (linguistic - verbal, logical - mathematical, visual - spatial, intrapersonal, interpersonal, musical, physical and naturalistic According to the model, the main metacognitive elements, such as self-observation, self-regulation, flexibility, recognition, discrimination and memory are considered multilevel processes and not The same is true for cognitive processes. As we ascend to a level they manifest more advanced and refined characteristics and functions that meet the needs of the subjects for the creation of abstract mental representations, motivations, thoughts and feelings of the upper class. The rise from the lowest to the highest levels of metacognition is directly intertwined with both advanced forms of self-knowledge and high levels of self-observation, which in turn presuppose ever-higher control processes. Each level of metacognition also describes a higher order control system, which operates according to a set of rules (Drigas & Mitsea, 2021).

Finally, the multilevel model of metacognition aims both at proposing an alternative approach and at clarifying that metacognition passes through strictly defined developmental stages. The conclusion that emerges from all this described research process is that the existing educational systems should pay attention to the creation of appropriate metacognitive learning environments, which will promote systematic education at each specific metacognitive level (Drigas & Mitsea, 2021).

The 8 Pillars of Metacognition. At the highest level of metacognition is the level of expertise where the person moves away from the illusions that may exist in his life. In order to be able to reach this level, the person must be very capable and have overcome all his cognitive and emotional temptations. In this way, it will lead to the immediate solution of problems and will remove any emotional and cognitive limitations and through knowledge will be able to gain stability. According to Rogers (1951) the individual, reaching the highest level, acquires spiritual knowledge, recognizes himself in depth and is not influenced by social pressures. At this level, knowledge is a tool of self-regulation that the individual has for himself. (Wilber, 2001). Finally, reaching the first peak of the pillar where transcendence and the mechanism of self-regulation are, the individual achieves complete success in terms of synchronizing with himself and with others. (Drigas, A. & Mitsea, E. 2020).

A New Layered Model on Emotional Intelligence. Emotional intelligence based on the pursuit of human cognitive abilities that transcends classical academic intelligence. It is also directly related to the theory of self-regulation and the theory of metacognition. Moreover, the EI focuses on the character and aspects of self-control, such as the ability to delay pleasures, tolerance of frustrations, and proper management of impulses (Drigas & Papoutsi, 2018).

Knowledge includes processes such as attention, memory, assessment, language problem solving and perception. Metacognition is defined as the ability of the individual to monitor and reflect on his own performance and abilities during the learning process. Along with the primary emotion, the individual simultaneously develops thoughts and performs cognitive functions that evaluate the relationship between emotion and judgment. In this way the person can manage his emotional reaction and thus have better interpersonal interactions. So, applying metacognition in socio-emotional contexts can correct emotional mistakes (Drigas & Papoutsi, 2018).

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The study of Drigas & Papoutsi (2018), below is the Pyramid of Emotional Intelligence, which develops from one level to another through metacognitive processes. It consists of a 9-level model:

Emotional unity (Pure Consciousness, Filling & Emptiness), Transcendence (Self-reflection, Transcendental Knowledge), Universality of Emotions, Self-Realization (Self-Perfection, Self-Achievement), Social Skills, Specialization in Emotion Review, Management), Social Awareness, Empathy ,Emotion Discernment (Awareness, Monitoring, Social Recognition & Flexibility), Self-management (Self-regulation, Flexibility, Self-control), Self-knowledge (Self-perception, Awareness, Self-observation), Recognition, Perception-Expression of Emotions (Memory, Perception, Recognition, Signaling of Emotions), Emotional stimuli (Coding of Emotional Senses, Attention).

4. AI in education. According to Dhankar and Walia (2020), Artificial Intelligence is an element of the IT industry, through which a machine is given the opportunity to reproduce the characteristics of man, that is, to think and behave like him. However, empathy and consciousness are elements that are impossible to reproduce by machines.

As for the Artificial Intelligence techniques that have been used from time to time according to Driga s and Ioannidou (2012), they have contributed to the improvement of the lives of people with special learning needs. It is important that the field of Special Educational Needs covers a large number of difficulties that hinder the learning process. Thus, the article discusses how students with sensory or physical disabilities need educational services that will help them maintain their independence and well-being. Due to the fact that the diagnosis is made by the specialist doctor, the applications of artificial intelligence have focused on the education of students. One of these applications is the program "Dedalos" introduced by Drigas et al, in 2008, which aimed to teach English as a second language to people with hearing problems whose mother tongue is Greek sign language. This is adapted to the needs of the student and provides an opportunity to assess his language skills, while also regulating the material.

Next, it is reported that for students who have difficulty reading and writing, teachers have access to certain diagnostic and intervention tools. Hernadez et al. (Cited in Drigas etal., 2012) presented the "Special System for Learning Disabilities" which recognizes learning disabilities and includes a knowledge base for Psychopedagogical assessment, which helps to create the psychological profile of the student.

In addition, the most common phenomenon of learning disabilities is dyslexia, for which Kohli et al. (Cited in Driga set al., 2012) used artificial neural networks (ANNs) to address the problems of identifying dyslexia. In addition, Melis et al. (Cited in Drigaset al., 2012) introduced the ActiveMath program to teach mathematics and evaluate student performance through the exercises and feedback provided.

Regarding Autism Spectrum Disorder, Drigas et al. report that Artificial Intelligence has facilitated timely intervention, while providing powerful tools that reveal the level of autism spectrum disorder. A typical example is the creation of the platform for adolescents with High Functional Autism by Riedl et al., With the game of creating the social scenario that examines the handling of unpredictable student action (cited in Drigas, 2012).

Educational robotics in Primary Education. According to the study of Drigas et al. robotics using LEGOwedo and LEGO Mindstorms can encourage students with autism to master: the skill of collaborating through storytelling. More specifically, you create development at all levels such as the cultivation of language skills and teamwork and collaboration. Still, through transnational activities you cultivate consciousness. Today, diagnostic robots are child-friendly and help them develop emotionally through interaction with

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them. Thus, many students today analyze the use of robots and their interaction with users and especially with children. For this reason, quite large equipment has been created at a high level and specially designed for people with autism (Drigas, et. Al. 2020).

5. Diagnosis of autism through AI. The majority of studies for ASD, by extracting functional magnetic resonance imaging (fMRI) data while performing a task, have been performed with adult or mixed groups of adolescents and adults. People with ASD are compared with standard controls. Task-related fMRI studies focus primarily on activating specific nodal areas of brain social function, including the DMN (Default Mode Network) areas described below (Padmanabhan, Lynch, Schaer, Menon 2017).

Studies focusing on the self-reported process, which require self-related in relation to other-related seizures, show reduced activation in the PCC (cingulate posterior cortex) and mPFC (prefrontal cortex). A study comparing the neural response to ventral mPFC with stimulation of self-related seizures relative to other-related seizures showed preferential activation of this area for self-related seizures in neurotypically controlled adults, but not in adults with ASD. Analysis of multivariate models further shows that in adults with ASD, that the PCC in particular, are not sensitive to the semantic processing of words that suggest social interactions.

The theory of mind. The theory of mind and the meaning of behaviors usually involve the projection of images, animations or stories and tests of participants in understanding the intentions or mental states of others. Overall, these studies report decreased TPJ (temporomandibular joint, brainstem) and mPFC stimulation, and decreased TPJ connectivity with the left lateral temporal cortex in adults with ASD (Padmanabhan, Lynon, Schaer, 2017). . There have been far fewer task-based fMRI studies in children with ASD, most likely due to difficulty performing tasks, compliance, and excessive head movement. There is no clear evidence that differences in people with ASD may be age-dependent.

Autism Diagnostic Interview-Revision (ADI-R). It is one of the most commonly used instruments to assist in the behavioral diagnosis of autism. The exam consists of 93 questions to be answered by a healthcare provider in a focused session that often lasts 2.5 hours. This study used machine learning techniques to study the complete ADI-R response sets available on the Autism Genetic Research Exchange (AGRE) for 891 people diagnosed with autism and 75 people who did not meet the criteria for diagnosing autism (Dally, Luyster , Jung, DeLuca, 2012).

. The analysis showed that 7 of the 93 items contained in the ADI-R were sufficient to classify autism with 99.9% statistical accuracy. The researchers further tested the accuracy of this 7-question classifier against complete sets of answers from two independent sources, a collection of 1,654 people with autism from the Simons Foundation and a collection of 322 people with autism from the Boston Autism Consortium. In both cases, the classifier was rendered with almost 100% statistical accuracy, correctly categorizing all but one of these two resources previously diagnosed with autism through the standard ADI-R Wall DP, (Dally, Luyster, Jung, DeLuca, 2012). The ability to measure specificity was limited by the small number of non-spectrum cases in the research data used, however, both real and simulated data showed a range of specialization from 99% to 93.8%. With the increase in frequency rates, the ability to diagnose autism quickly and effectively requires careful planning of behavioral assessment methods. This study is an initial attempt to retrospectively analyze large data repositories to derive an accurate but significantly shortened approach that can be used to rapidly detect and clinically prioritize individuals who may have autism spectrum disorder. Such a tool could help streamline the clinical diagnostic process as a whole, leading to faster screening and prior treatment of people with autism (Dally, Luyster, Jung, DeLuca, 2012).

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Researcher tool DBC. The following research was completed by Monash Medical Center in Melbourne, Australia. The aim of the research is to study the development of the child. A sample of 638 cases was used, of which 50% consisted of people with autism. Expert doctors who had experience in Autism followed all the "golden standards" to be led to the diagnosis. They then collected another set of 100-case cross-validation data (62% Autistic Disorder, 38% without Autism Disorder) collected in Sydney at 3 separate child development clinics (Leichhardt, Tumbatin and Kogarah clinics). For both datasets the variables consisted of 96 DBC elements (tool-graph) completed by a parent / guardian. IQ level is coded as severely disabled, moderately disabled, mild disability. The diagnosis of autism is coded according to the DSM-IV criteria. The use of technology played an important role in the diagnosis of mental health. The aim of the study was to compare an MLP (artificial neural network) neural network with a Logistic Regression to see if the MLP Neural Net was a better diagnostic classifier (Hosmer & Lemeshow, 1989).

The DBC-NN compares favorably with other commonly used tools and practices in terms of validity. None of the other tools has used a cross-validation test, which gives the most accurate indicator of a diagnostic classifier's classification ability. However, the agreement between clinics for the diagnosis of autism was found to be 85% according to studies in the DSM-IV field. Since a clinical diagnosis using DSM-IV criteria is a standard for diagnosing autism, 85% is the maximum validity agreement any other method can have. DBC-NN is at 80% and is close to this theoretical ceiling and therefore performs relatively well (Florio, T., Einfeld, S., Tonge, B., & Brereton, A., 2009).

Classical encephalograms (EEG). Studies that have tried to use EEG recording (= Classic encephalograms) to diagnose autism do not vary. Barttfeld (2011) examined the differences between functional connectivity and small world brain networks in the delta (D) frequency band between individuals with ASD and non-ASD. The researchers found that children with ASD generally had lower long-range connectivity in frontal-occipital joints and higher short-range connectivity in lateral-frontal joints. This means that the topology of the brain network deviates significantly from the small world network, which is necessary for high speed and strong transmission of information to the brain (P. Barttfeld, B. Wicker, S. Cukier, S. Navarta, S. Lew, M. Sigman, 2011).

Machine learning algorithms with mMSE. In another study, Bosl et al. showed that the use of multiple-scale endotropy mMSE (Mini-Mental State examination: clinical method for classifying cognitive impairment, produces a score that can be used to monitor the course of patients), as a feature carrier, makes it possible to distinguish infants at high risk of autism from typical developing controls (W. Bosl, A. Tierney, H. Tager-Flusberg, C. Nelson, 2011).

Using various mMSE learning algorithms as a feature carrier, infants were classified with more than 80% accuracy into control groups at 9 months of age. Classification accuracy for boys was close to 100% at 9 months of age and remained high (70% to 90%) at 12 and 18 months. This study suggests that mMSE, calculated from EEG encephalography signals during a resting state, may be a useful biomarker for early detection of the risk of ASD and cognitive developmental disorders in infants.

A few years ago, researchers developed a methodology called "Silent Operation." More recently, in an attempt to develop it, they proposed a variant of this technique called "Multi-Scale Organizational Maps (MS-ROM) / Silent Operation as Compression Time" (I-FAST). a new, complex algorithm that deals with the classification of the initial EEG detection, recording and analyzing a few minutes of the EEG encephalogram without prior pretreatment (M. Buscema, P. Rossini, C. Babiloni, E. Grossi 2007).

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This pilot study was applied using the same methodology to a group of 15 children with ASD and 10 proven standard developing children.

The total predictive capacity of the machine learning system in the classification of autistic cases from the normal control was consistently 100% with all types of systems used using the training test protocol and 84% - 92.8% using the protocol called Leave One Out . The similarities between the ANN (artificial neural network) weight tables measured by the attack algorithms were not affected by the age of the individuals. This suggests that ANNs do not read age-related EEG patterns, but analyze the unchanged features associated with the underlying brain detachment.

Genes and AI. Autism and other developmental disabilities, clinically referred to as Autism Spectrum Disorders (ASD), are characterized by disturbances in communication skills and social interaction and the presence of repetitive stereotyped behaviors and interests. It is usually diagnosed from the age of three and has a prevalence of 60-70 per 10,000 children in broader diagnostic criteria according to the latest estimates. ASD is considered one of the most inherited of all psychiatric disorders. A recent study started based on the twin population of 10,895 twin couples and reported 80% heredity for ASD (Bailey, A., Gotesman I, Bolton, P., Le Couteur, A., 1995).

Subsequently, completed studies on candidate gene binding and whole-genome correlation have shown various genes and chromosomal regions associated with ASD disorder. However, none of these known causes alone account for more than 1-2% of cases, and specific genetic mechanisms governing the inheritance of the disorder remain largely unknown. cause indistinguishable ASD features. This genetic heterogeneity requires the search for more likely candidate genes associated with the disorder (Marini M, Bocciardi R, Gimelli S, Di Duca M, Divizia MT, 2010) A role of the 5HTergetic system in the pathophysiology of autism has been proposed based on the following observations, (Anderson GM, Gutknecht L, Cohen DJ, Brailly-Tabard S, Cohen JH, 2002).

a) Hyperorotonemia in whole blood cells and platelets of 25-50% of patients with autism.

b) tryptophan 5HT precursor depletion in ASD patients increased some stereotype behaviors associated with the disorder.

c) treatment with selective serotonin reuptake inhibitors has been shown to be effective in improving compulsive behaviors in autistic individuals.

d) Recent neuroimaging studies have shown low levels of 5HT brain synthesis in autistic children and decreased serotonin transporter (SLC6A4) binding in different areas of the brain in both children and adults with the disorder. According to these reports, several genetic correlation studies involving genes involved in 5HT metabolism have been attempted with an emphasis on SLC6A4. While several SLC6A4 polymorphisms have been shown to be associated with the disorder in some studies (Chandana SR, Behen ME, Juhasz C, Muzik O, Rothermel RD, 2005).

Transcription factor LMX1B. Given the importance of LMX1B in the development of 5-HTergic neurons, the following study analyzed its role in autism. A tripartite study was performed here to examine the association of LMX1B with autism. The changes in LMX1B in brain samples after death of patients with autism were then evaluated, and then compared with healthy controls.

In this study, the relationship between the LMX1B transcription factor gene and autism in the Caucasian population was examined. In the three-step study, nominal correlations were found for two SNPs (single nucleotide polymorphisms and mean that there is a single nucleotide change in a gene). This is the first study to report an association between LMX1B and autism.

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Both SNPs found to be associated with the disorder are found in introns. It has also been observed that LMX1BH of mRNA is rather low in the brain of autistic adults (Haznedar MM, Buchsbaum MS, Metzger M, Solimando A, Spiegel-Cohen J, 1997).

In conclusion, a possible association of the transcription factor LMX1B with the pathogenesis of autism is recorded. However, these results should be interpreted with caution, given the limited sample of postmortem brain samples and the moderate correlations used in genetic and gene expression studies.

Functional Magnetic Resonance Imaging (fMRI). It is a neuroimaging process that aims to evaluate the functional activity of the brain which is related to the detection of changes in blood flow during specific stimuli. The BOLD (Blood Oxygen Level Dependent) technique is the main fMRI technique and depends on the content of deoxyhemoglobin in the blood to indicate neuronal activity (Iliopoulos, 2020).

Although fMRI is indeed one of the most recently used neuroimaging methods, the basic idea behind the technique is quite old. This idea is based on the assumption that brain activity requires blood flow so it can be assessed through measurements of changes in blood flow. The protein compound that is responsible for transporting oxygen to the lungs, tissues and various organs of the body such as the brain is hemoglobin. The key to understanding the phenomenon is that hemoglobin is diamagnetic when it is in its oxygenated form while in its non-oxygenated form it is paramagnetic (Tsougos, I. 2018).

It is understood that the degree of differentiation of oxygenation in the blood changes the local magnetic properties, thus leading to small variations in the signal, which may indicate brain activity. FMRI is widely used in clinical practice, although it was started mainly in the research area, where its original application was to map brain activity or which was caused by stimuli or tasks (aesthetic, motor, cognitive or emotional) in healthy volunteers. . The non-use of ionizing radiation as well as its temporal and spatial resolution are what make fMRI superior to other technologies and applications (Tsougos, I., 2018).

The BOLD effect. Then the BOLD phenomenon is reported. According to this phenomenon, brain function requires a large amount of energy. In addition, the brain can reach up to 20% of the rate of oxygen consumption required for the whole body and 15% of blood flow. This energy is provided in the form of ATP which is produced from glucose through oxidative phosphorylation (Tsougos, I., 2018). Therefore the rate of oxygen consumption can be assumed to be a good indicator of the rate of energy consumption. The oxygen required by the brain for its metabolism is supplied through the bloodstream and so the high demands of the brain for oxygen during a task stimulus result in increased oxygen supply and consequently increased blood flow (Holte, 1993).

An important factor in fMRI is the presence of hemoglobin. When oxygen is not bound to hemoglobin, it is called deoxyhemoglobin and is characterized as a paramagnetic substance (small, positive magnetic susceptibility), while when oxygen is bound to hemoglobin it is called oxyhemoglobin and is characterized as a magnetic substance ( ). As a result, areas of the brain with increased deoxyhemoglobin have a less homogeneous magnetic field and therefore less MR signal than areas with oxyhemoglobin. More specifically, there will be a magnetic difference of about 0.08 ppm between fully deoxygenated and fully oxygenated blood (Iliopoulos, 2020). Therefore, the term "activation" of the brain can be misleading because it refers only to changes in the signal strength of a small percentage, which explains why the subsequent processing of data from fMRI experiments still presents challenges and difficulties. Thus, the higher the strength of the magnetic field, the higher the BOLD signal recorded in fMRI experiments, making it easier to process the data.

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DL Models. Today, DL is widely used in image processing, pattern recognition, and more recently in healthcare, such as for extracting related patterns from electronic health records. A deep neural network (DNN) is an artificial neural network (ANN) with multiple levels between the input and output levels. DNN finds the right mathematical manipulation to convert input to output, whether it is a linear relation or a non-linear relation. DL models are inspired by information processing and communication patterns in biological nervous systems (Bengio, 2009, Schmidhuber, 2015).

The presence of prenatal and neonatal risk factors in the development of ASD suggests the desirability of neonatal screening for this disorder. The use of DL and other ML techniques to detect autistic disorder was then considered, based on the DNA methylation status of the newborn leukocyte DNA. In addition, based on the epigenetically altered cytosine sites, this possible epigenetic pathogenesis of autism was studied.

Machine Learning (ML). Provides New Opportunities for Human Behavior Research and Clinical Translation. However, its implementation may have set pitfalls (Bone, 2015). In the following research, ML machine learning was used to derive autism spectrum disorder (ASD) algorithms as part of an effort to improve the widely used autism screening and diagnosis tools (ASD).

According to the results of the research, the algorithms created were more efficient (higher performance) than the current algorithms, and were coordinated (sensitivity and specialization can be weighed differently) as well as more efficient (achieving near-peak performance with five or less codes). At this point, the ML-based fusion results of ADI-R and SRS are reported. Using a screener algorithm for under 10 years of age, it was observed that the sensitivity reached 89.2% (Boneetal., 2016). ML is useful for creating powerful, customizable algorithms. In a unique data set consisting of controls with other difficulties, our findings highlight the limitations of the caregiver's current reporting tools and suggest possible pathways for improving ASD control tools and diagnostics.

6. Robotics Intervention in Autism. Nearly ten years ago, Stanton et al. indicated intimacy between children and robots. Initially, they investigated the interactions between four children with autism and a humanoid robot named Robota. At the beginning of the research, two of the four children showed great interest and had a good interaction with the robots. The study then looked at 11 children with autism using, Aibo was used as a robotic dog and Kasha as a mechanical dog. The children were in the same room with both dogs and the results showed that the children had more time to interact with the Aibo than with Kasha. . Still, with Aibo they had cultivated more language as they had more linguistic interaction. The same happened with the social interaction that the children had. After six years, the research of Barakova et. Al. Examine the interaction of children with autism with Lego. The goal was to replace the human presence with the presence of robots. In conclusion, the use and construction of Lego led to great results such as a) the game based on the robot scenario in which the game continues during the sessions opened opportunities for great - interventions using robots and led to a significant increase in social initiations during intervention in natural environments. b) includes binary interactions between a robot and a child with robot toys has a positive effect on the child's interactions and the creation-learning moments that are consistent with the chosen therapeutic approach (Drigas et. Al. 2020).

Research on the treatment of autism through AI . At the same time, according to research by Fiske, Henningsen and Buyx, there are other types of AI robots that provide opportunities with different forms of involvement in children with autism spectrum disorders (ASD) . Like the Kaspar robot that has shown potential for integration into current education and treatment interventions and is exploring the possibility of improving social skills among

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children (Mengonietal., 2017). Similarly, RoboTherapy is an example of social assistance robotics designed to help children with ASD develop social skills. The Nao robot is designed to improve facial recognition and proper eye response. The goal of such a robotic interaction is to teach children appropriate social skills (eg imitation, staying, and empathy), in the hope that they can then apply the robot-learned skills to their human relationships.

Artificially intelligent robots are also being explored in a variety of other areas of mental health, including mood and anxiety disorders, children with behavioral disorders, and patients who may not have a specific diagnosis but who will benefit from mental health assistance (Rabbitt SM, 2015).

Social robots SAR. According to Esteretal., Socio-economic changes and the lack of healthcare professionals to meet the ongoing demand for services and care have led to the need for technological solutions to alleviate this situation. The scientific answer to these questions is auxiliary robotics and, more specifically, socially auxiliary robotics, which incorporates a human-robot interaction in a social way. Neuroscientific data show that users, especially children, tend to interact with robots better than traditional monitors. In general, robots tend to use bright colors, striking shapes and lights, thus attracting the attention of children (Cabibihan, 2013).

As the availability of the therapist is limited, SARs (social assistance robots) must be developed with a certain level of autonomy in order for the treatments to take place. Machine learning provides solutions to the problems faced by these systems, such as eye tracking and face recognition or automatic speech (Esteretal., 2020).

As for eye monitoring, it is used to measure the patient's attention to the robot. There are commercial solutions for this purpose, but they are costly. Traditional techniques are based on shape-based methods, observing, for example, the edges of the iris or the center of the pupil of the eye (Valentietal., 2011). Traditional methods also have a problem when conditions are not ideal and stable: recognition rates are reduced by variations in facial posture and changes in lighting conditions. However, machine learning again gives us the solution to both. It offers cheap camera devices and has adopted architectures that go far beyond traditional methods (Esteretal., 2020).

More recent works already predict the patient's emotions and moods from eye monitoring data using repetitive neural networks (Simsetal., 2019). The study of the patient's gaze is a technique that, in addition to diagnosing autism, also helps to measure the effectiveness of the child's interaction with the robot (Esteretal., 2020). The robot must be adjusted to adapt its behavior to new conditions and the needs of users, which is not so simple and is a challenge. (Tapusetal., 2008). Artificial intelligence and machine learning play a leading role in this (Esteretal., 2020).

Robot NAO. According to research by Palestra, Berardina and Esposito (2017), it gives details about the NAO robot. In particular, it presents an artificial intelligence system based on a robotic treatment for autism. The robot acts as a social mediator, trying to provoke specific behaviors in autistic children. The experiments performed and which will be reported below focused on the study of eye contact in these children and its improvement. This is especially important for enhancing interpersonal communication (Jeffries,, 2016).

Robot therapy requires them to have or simulate intelligent behavior and interaction, based on human speech, body language, language comprehension, emotion recognition and eye contact ability, and other characteristics of intelligent behaviors. Building a successful treatment for children with autism requires a multidisciplinary effort. Therapists, psychologists, robot programmers and researchers are involved in designing robotic treatment protocols for autistic people (Palestraetal., 2017).

Barakova and Lourens (2013) present three ABA interventions based on the NAO robot. As for the NAO robot, it is a humanoid robot, 60 cm tall, walks, talks, dances (www.softbankrobotics.com) and helps people with autism improve their facial expressions and maintain proper eye contact. It plays a leading role in treatment. This treatment focuses on enhancing the eye contact of autistic children. The treatment protocol is designed to improve a difficult behavior for an autistic child. It is based on the ABA program which includes: a stimulus presentation, a behavioral response and an reinforcement (Palestraetal., 2017).

Robot Kaspar. Researchers Zaraki, Dautenhahn, Wood, Novanda and Robins aim to study the learning and communication development of autistic children through interactive games that they can play with the "Kaspar" robot. Kaspar is a robot the size of a small child. It mainly uses facial expressions and natural gestures (hand movements, eye contact), in order to interact with people. He is almost 60 cm tall and sits in a stable position. The main body of the robot contains electronic boards, batteries and motors. The Kaspar robot also has 18 FSR pressure sensors on various parts of the body, such as the arms, shoulders, head, and legs to detect tactile interaction. His system has several programmed behaviors such as opening and closing his mouth and eyelids, smiling, singing and waving his arms and legs. Finally, his eyes have video cameras to have visual contact with the child (K. Dautenhahnetal., 2009).

In the Gauravetal research. (2013) showed that the autistic child felt uncomfortable maintaining eye contact with a human, but with the robot he did not seem to have difficulty looking him in the artificial eyes. This is why an auxiliary robot seems to be very effective for the autistic child as the child can interact better with robots compared to a therapist (WerryI. 2001).

The research robot gives the child a few words to pronounce. Depending on the child's performance increases or decreases the level of difficulty using machine learning algorithms. Specifically, the process is as follows: The robot tries to gain the child's attention with various movements. Once this is achieved, the robot shows the child an object. When the child notices the object, then the robot pronounces its name where it is a word for monosyllabic beginning. If the child pronounces the word correctly, then he continues to the next levels where now the words pronounced become two syllables and three syllables (Gauravetal., 2013).

A method has been defined for the detection of children's ocular pattern that is sufficient to detect the pattern of the eye at any time (P. Ravindra, 2009). In conclusion, this method is suitable for enhancing attention and understanding of speech of autistic children. A robot can correctly compare the child's pronunciation with the recorded ideal database while humans can not perform this function with great accuracy (Gauravetal., 2013).

AIntelligence in the Evaluation of Autism. Yuan used NLP Techniques with machine learning based on information extracted from medical form on the capabilities of patients with ASD. The results of these tests are evaluated by specific clinical responses. As a result, the proposed system achieved 83.4% accuracy and 91.1% recall. In addition, WearSense was used to detect the stereotypical behavior of people with autism. More specifically, an integrated accelerometer was used to detect the typical behaviors of individuals belonging to the autistic spectrum. WearSense is a smartwatch that collects sensory data through a smartphone, and through machine learning algorithms classify sequential behaviors. In this way this technology can help clinicians collect data correctly with 96.7% accuracy in detecting autistic behaviors (Drigas et al. 2020).

Project Aurora. The Aurora project is aimed at children aged 8-12 years and goes through 3 phases through which the usefulness of robots in the life of autistic children is proven, as well as the children's preference for them. The first phase focuses on five children, who interacted with the robot, which gradually approached them. The condition was that the children

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were not afraid of the robot and wanted to interact with it for a period of 10 minutes or more. The second phase explores the difference in children's interest between a robot and other toys that children can not interact with. This phase involved 18 children, who turned out to be more interested in the robot than other toys. Finally, in the third phase, 3 pairs of children participated. It was studied whether the robot can act as a mediator in the relationship between the two children. The results were again satisfactory (I. Werryetal., 2001).

Chatbot. The Xuanetal. (2020) argue that chatbots that have been designed so far have several limitations such as not adapting to the language comprehension of autistic children. Therefore, in the present research, a Chinese chatbot is designed, based on machine learning, which has been adapted according to the language habits and comprehension skills of the children. Contains sentences as short and simple as possible to facilitate comprehension. The chatbot's imagination has improved significantly and allows him to generate appropriate responses even when the child utters only one word. Taking into account the ages of the children, the chatbot chooses the most appropriate vocabulary and is designed as an optimistic personality that will inspire children.

In conclusion, according to Xuanetal. (2020), this chatbot designed specifically for autistic children, can and does simulate a realistic social environment where it allows children to put into practice what they are learning in the real world. Finally, it is a useful tool for therapists and researchers. As the chatbot can be placed on computers, mobile devices or robots, voice data is recorded so that researchers and therapists can collect, process and work accordingly. For the above reasons we understand that the chatbot will be an important tool that will help treat autism, especially in terms of improving speech and expression in children.

Research about the relationship between children and computer. Continuing, we will refer to another research that concerns the difficulties of autistic children in speech. According to researchers Sharmin, MizanurRahman, Ahmed and MustafizurRahman.

The main idea of the game is simple. The facilitator selects different types of images that depict different objects to be displayed on the child's screen. The child tries to pronounce the name of the object. The computer system that can and does recognize audio, receive it and convert it to text. This text is then passed on to the moderator where he examines it and confirms whether it is correct or contains errors. Each answer is stored on the computer base so if the children's answer is wrong, then the process continues with images related to their mistakes and others. If the answer is correct, an animation appears that rewards them and the process continues again (Rahmanetal., 2011). The results of the research seemed to be satisfactory as this computer game was considered effective. Its performance, according to data and statistics, was higher than other methods, traditional and modern based on technology (Rahmanetal., 2011).

Virtual Reality (VR). A promising tool has recently appeared in many areas of recovery, called virtual reality. Virtual reality (VR) is a real-world simulation based on computer graphics and can be used as an educational and therapeutic tool by educators and therapists to provide children with a safe learning environment (M. Bellani, 2011).

Two studies have been conducted to demonstrate the effectiveness of virtual reality. The first study reported that using a virtual environment, specifically a "virtual cafe", to teach social skills, the speed of execution of projects in the virtual environment improved after each repetition. The same study showed an improvement in the understanding of social skills. In the second study, which reproduces a "virtual supermarket" with several exercises on the physical, functional and symbolic use of objects, it was found that the performance of the participants, which was evaluated by a trusted test, increased greatly with the intervention of the virtual environment and one child succeeded. instantly transfer the skills acquired from virtual reality

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to the real world. Finally, more general studies that have studied the emotions of autistic children and whether they are capable of recognizing emotions, with the interaction of child and Avatar, have shown that children can thus improve their sociability and acquire the feeling of empathy (M. Bellani, 2011).

In conclusion, the use of virtual reality (VR) tools to familiarize with autism is very promising and can help therapists and educators to enhance the daily social behaviors of children with autism (M. Bellanietal., 2011).

Finally, the Kandalaftetal. (2013) designed a virtual reality intervention to improve the social mental skills of adults with autism. Adults, averaging 21 years old, practiced through written scripts in which they played a variety of roles during a virtual interaction with an online multiplayer entertainment game. Two facilitators (clinics) were available to provide any assistance. Scenarios focused on social interaction including in-room conversations, meetings with strangers, in-store negotiations, job interviews, a friend's consolation, blind dates, and more. The virtual reality characters are modeled to look like the participants. This treatment includes 10 sessions and although it did not show dramatic improvements, these were visible at all levels and in most of the scenarios requested in the children.

Virtual Environment. According to Manju et al. (2018) the following research concerns a treatment for children with autism, which is based on the virtual environment and the enhancement of their emotions, attention and social skills. More specifically, children interact with the virtual environment through a series of activities. The virtual environment has three levels related to attention training, social and emotional skills and decision making. During the process, the system was surrounded by cameras, a surveillance system, a gesture recording system and an audiovisual recording system. Virtual environment rehabilitation therapy has been shown to have positive effects on repetition and has helped to address attention deficit, social interaction and emotional value in children with autism. In addition, Didehbani and her colleagues published an article in 2016 in which they spoke about the very importance of adopting virtual reality programs and methods to improve the social and emotional skills of children with autism problems and disorders. The study investigated the impact of a Virtual Reality Social Knowledge Training (VR-SCT) on enhancing social skills in 30 children with ASD. The results showed that VR-SCT contributed to the improvement of emotion recognition, social performance and the executive function of analog reasoning (Drigas, A. & Papoutsi, C. 2021).

Mindfulness and Robots for Autism. Autism is a complex neurobiological and at the same time multifactorial disorder, which is governed by specific cognitive deficits. The aim of the authors of the present study is to analyze the dysfunctions that characterize people with autism in both language and attention, but also in control and memory, based on scientific studies. The cognitive deficits that characterize people belonging to the autism spectrum are the following: Quality deficiencies in language and communication, and deficits in memory capacity. In addition to the cognitive deficits that are directly linked to autism, researchers are focusing on both the characteristics of these individuals and their functionality, and use robots as tools for intervention and treatment in people diagnosed with autism. Finally, the use of robots in the learning process has been shown to reduce the cognitive and sensory deficits of individuals with this disorder while enhancing the development of metacognitive skills (Mitsea, Akrivopoulou, Lytra & Drigas, 2020).

The fact that robots are so beneficial to people with autism suggests that familiar people actually prefer contact with robots to humans because robots are simpler, more predictable, and more repetitive. and robots should definitely mention the advantages that govern this process. These include enhancing imitation, attention, promoting communication skills, and

encouraging social interaction. Art and play, as mentioned in the analysis of previous research, have proven to be very effective ways to promote the self-regulatory skills involved in learning (Mitsea, Akrivopoulou, Lytra & Drigas, 2020).

Continuing, activities based on consciousness promote executive functions, such as activating control mechanisms and controlling attention skills. Programmed robots contribute to the cultivation of the highest cognitive, social and emotional abilities. There is a lot of research that has been used - and we could say it has been used - to explore issues related to autism spectrum disorder, such as whether people with autism can benefit from improved cognitive and metacognitive skills. Based on the results there are significant improvements (Mitsea, Akrivopoulou, Lytra & Drigas, 2020).

Based on the results of the relevant study, the metacognitive mechanism of autistic individuals who participated in the research process, when dysfunctional leads to deficits of an emotional and cognitive nature. In particular, control processes, such as behavior control, result in behaviors characterized by repetition, rigidity, and apathy. Deficiencies in control are interdependent and coexist with dysfunctions in memory and attention functions. The purpose of the study was to investigate (Mitsea, Akrivopoulou, Lytra & Drigas, 2020) The effectiveness of robots as tools for improving cognitive and metacognitive dysfunctions leading to new brain structures, higher levels of intelligence and higher states of consciousness. with autism prefer robots because of their appearance and the small range of emotions they are programmed to have. At the same time, it should be noted that the design of robots is always done according to the age, the real needs of children with autism who will participate in the respective research. In addition, they can be programmed in such a way as to "adopt" desirable behaviors such as imitation, attention, initiation of communication and interaction, and social behaviors (Mitsea, Akrivopoulou, Lytra & Drigas, 2020).

Conclusions

It is understood that the influence of AI is helpful for the lives of people with autism, as it has greatly facilitated it through various applications. The main goal is to improve the quality of life of these people, through the development of skills. In addition, although the reproduction of emotion by machines is difficult to achieve, applications have been created that target it. In addition, the plethora of tools and tests available for use, specifically for this disorder, is an excellent database and information and is a very promising tool for future more extensive investigation, as it is easy to modify and evolve according to the requirements . Remarkable are its multiple benefits in the life of the child with autism, as it offers him self-esteem, self-confidence, enhances his creativity and cultivates his critical thinking.

Finally, according to our research, artificial intelligence helps to improve the deficits of autistic children that may be related to inability to socialize, speech, eye contact, etc. Her next role is important in the diagnosis and treatment of ASD.

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