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Internet-based treatment for Autistic Spectrum Disorder: An overview

Shuman Liu[1,4,5,†], Yixin Wang[2,,6,†], Zixuan Sun[3,7,†]

[1]University college London, London, WC1H 0DP, UK
[2]Tsinglan School, Dongguan, 523808, China
[3]Shandong Experimental High School, Jinan, 250001, China
[4]Corresponding author

[5]3389595373@qq.com
[6]20250171@tsinglan.cn
[7]berasun0319@gmail.com
[†]These authors are co-first authors

Abstract. Internet-based therapies have emerged as effective alternatives to traditional face-to-face therapies, demonstrating efficacy in treating mental health problems and providing accessible care, especially in this post-pandemic world. Moreover, the unique characteristics of the Internet offer promising opportunities to cater to the unique requirements of patients diagnosed with Autism Spectrum Disorder (ASD) , emphasizing profound impact that can be achieved through internet-based therapy in revolutionizing existing therapeutic paradigms. However, investigation of online therapy for adults and older individuals with ASD is currently limited. This systematic review provides a summary of the status of existing research investigating the application of Internet-based therapies on individuals with ASD, including Virtual Reality-based interventions, Artificial Intelligence-based interventions and other online therapies. The primary objectives are to assess the efficacy of Internet-based therapies as treatments for individuals with ASD. Additionally, potential differences between Internet-delivered therapies and traditional face-to-face therapies are also being explored. By providing a comprehensive analysis of both Internet-based and traditional therapy modalities, this review aims to contribute to our understanding and delivery of more effective therapeutic options available for individuals with ASD. Future directions on better therapeutic choices are discussed, as well as the need for addressing the existing research gap towards elder population.

Keywords: Autism spectrum disorder, internet treatment, VR, AI.

1. Introduction

Internet-based therapy, also referred to as online therapy or teletherapy, has gained substantial attention in recent years, owing to its convenience, accessibility, and potential benefits. After its inception during the early 1990s, this mode of treatments has leveraged the power of technology to remotely deliver therapeutic interventions and support through digital platforms thus bringing many advantages. Especially during the COVID-19 pandemic outbreak where access to offline treatments was substantially curtailed due to restrictions and safety concerns limiting access to offline treatments, the

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pivotal role of internet-based interventions was underscored [1]. Providing care via telepsychotherapy during the pandemic not only reduces travel time and lower health risk but can also be more private, reducing stigma concerns [2].

In contrast to other neurodevelopmental disorders, children with Autism Spectrum Disorder possess a specific pattern of impairments in communication, such as fewer conventional gestures, more echolalia and stereotypical phrases, limited functional use of language, and a reduced inclination to start or engage in verbal interaction [3]. Although the speech of autistic children is often noted to be grammatically correct, it deviates from typical functional language use. This means that while their grammar may be accurate, their speech lacks the expected social and pragmatic functions that are typically expected in communication. Consequently, individuals with ASD may struggle to effectively use language for social purposes, such as initiating conversations, maintaining back-and-forth exchanges, or expressing their needs and desires in a socially appropriate manner. Furthermore, individuals with ASD commonly exhibit intense and focused interests that differ from those without the disorder. These interests often manifest as highly specialized areas of knowledge or expertise, and individuals with ASD may demonstrate exceptional proficiency in these specific domains related to their unique passions.

Computational devices hold immense potential for patients with ASD, offering a stable, rule-based environment in which the speed of tasks can be customized to aligh with individual preferences, thus uniquely appeals to and benefits ASD patients [4]. The internet creates avenues for individuals with ASD to connect and interact with like-minded individuals who share their interests, thus helping them further explore their unique passions [5]. This specific advantage promises novel avenues to cater to the unique requirements of patients with ASD, illustrating the potential of internet-based therapy to revolutionize therapeutic paradigms.

In the subsequent sections of this review, we delve into the specific considerations surrounding internet-based therapy, including VR-based training and AI-supported interventions, for ASD individuals, exploring its feasibility, potential benefits, and the challenges it may surmount. By critically examining existing literature and empirical evidence, we seek to illuminate and bring attention to the transformative potential of this approach in redefining how we conceptualize and deliver therapeutic treatments for individuals with ASD.

2. VR

Virtual reality (VR) stands as an innovative computer-programmed technology that skillfully replicates real-world environments through the integration of vivid images, captivating soundscapes, and tactile feedback. This simulation encompasses a wide range of applications, including interactive video gaming, immersive virtual environments, and multisensory experiences, allowing them to truly immerse themselves in unparalleled digital landscapes [6].

VR has been demonstrated to be an efficient learning method for ASD child, providing an immersive and customizable environment that supports their educational needs [7]. It possesses advantageous features such as controllable input stimuli, modification for generalization, and individualized treatment, creating a primarily visual/auditory world which appears highly compatible with the preferences of effective learning methods for young patients with ASD, given that explaining abstract concepts to individuals with autism has shown effectiveness through the utilization of visual and auditory stimuli, which cater to their unique learning needs [8]. In a study that examines the effects of virtual travel training on children with ASD, a significant statistical increase in their understanding of the bus-riding process was observed. Additionally, the study reported a significant level of achievement in implementing strategies or actions in the game, reaching 93.8% [9]. This result indicates that VR-based serious games can be utilized efficiently to enhance independence of patients with ASD in outdoor activities.

VR has also shown promising results in enhancing performance skills of adult patients in areas such as driving skills, job interviewing and various other activities of daily living (ADLs). Ross et al have conducted studies assessing the use of specific VR-related treatment for driving [10]. The results have shown a notable increase in favorable attitudes and a decrease in unfavorable attitudes, in comparison

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to ASD parent drivers undergoing routine driver training. Burke et al and Smith et al have measured post-VR treatment job interview skills in response to the use of VR training session [11,12]. The findings indicated that adult participants with autism demonstrated notable improvements in various areas, including identifying personal strengths, promoting oneself, advocating for oneself, addressing situational questions, and effectively responding to behavioral and social inquiries. Smith et al have also shown that patients in the VR training group demonstrated greater improvement in their interview performances compared to those who didn't receive VR training [12]. Participants that received VR training also described finding the VR training system easy to manipulate and relatively pleasant, which in turn made them feel more comfortable towards future interviews.

In conclusion, Virtual reality (VR) has become a potent resource for autism intervention, offering unique advantages specifically to ASD patients. By providing immersive, customizable, and multisensory settings, VR caters to the unique learning preferences of individuals with ASD. The effectiveness of virtual reality (VR) interventions has been demonstrated in diverse areas, including driving skills, job interviewing, and social communication, indicating the potential of VR to enhance independence and functional abilities in individuals with ASD. The promising outcomes of VR interventions pave the way for further exploration and utilization of this innovative technology in supporting individuals with ASD, ultimately enhancing their quality of life.

3. AI

Recent advancements in utilizing artificial intelligence (AI) for the early detection and treatment of ASD have yielded promising results. These methodologies involve leveraging algorithms to identify distinctive ASD characteristics and streamline the assessment process by eliminating redundant items. For instance, Liu et al employed facial scanning patterns to differentiate between ASD and non-ASD individuals, achieving an impressive accuracy rate of 88.51% [13]. Notably, the ASD group displayed a preference for left-eye fixation, while the non-ASD group focused more on the right eye. Similarly, Crippa et al highlighted the potential of goal-oriented movement differences as a robust identifier of ASD [14]. In more recent studies, such as the work by Rubio-Martín et al integrated AI model with natural language processing (NLP) techniques have been employed to detect individuals with ASD with an accuracy rate of 84% [15]. This AI-driven approach not only facilitates early ASD detection but also plays a crucial role in enhancing various aspects of ASD individuals' lives.

Christina Whalen et al applied a varity of structured teaching apporaches to alliviate ASD child unappropriate bahviours, and enhance social skills [16]. Specifically, cognitive, social, receptive language and life skills along with non-verbal communication skills, as well in other aged ASD populations [17]. In addition, computer programm been proved useful in teaching child with ASD or Asperger syndrom to recognise and predict others emotins [18], however, the program only category emotions into happy, sad, angry or afraid. this design cannot reflex real world situations, as there are many more complex emotions, e.g., embarrassed, excited or guilty. Furthermore, few studies investigated use computer programm to impove emotion prediction for adults with ASD.

An innovative approach involved utilizing robots for ASD interventions. Farhan et al employed an autonomous humanoid robot named NAO to foster neurological and physical growth in ASD individuals [19]. The study involved multiple sessions, including verbal and non-verbal language, physical activities, and appreciation exercises. The results indicated NAO's effectiveness in improving communication skills among ASD patients. Also, a haptic robot been tested able to improve motor skills in ASD patients, in tasks like writing speed and glyph formation, albeit with limited effectiveness for children under the age of 9 [20]. Recent studies have delved into specific motor skills improvements for ASD individuals. Moorthy et al designed a robot to teach left-right shoe recognition and velcro band closure to ASD children, resulting in improved fine motor skills [21]. So et al compared robot-assisted interventions with human interventions, demonstrating the robot's effectiveness in enhancing motor skills and gestural production, with additional benefits like increased eye contact [22]. Furthermore, AI-supported interventions extend to teachers' roles. Escobedo et al demonstrated how well-designed "smart objects" can aid teachers in object discrimination training for ASD students, reducing their workload and

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enhancing cognitive efficacy [23]. These studies collectively underscore the immense potential of AI-driven interventions in the ASD domain. From early detection to fostering cognitive, social, and motor skills, AI continues to revolutionize ASD treatment methodologies, benefiting individuals, teachers, and families alike. However, those studies focused exclusively on children with ASD, and it remains uncertain whether robots could yield similar improvements in motor skills when applied to older individuals within the ASD population.

4. Other internet-based treatment

The following part summarized three internet-based treatments for ASD: Computer-Based Intervention, App-Based Treatment, and Caregiver Programs.

Computer-Based Intervention (CBI), a method commonly used in special education, serves as a supportive technique for teachers working with ASD children [24] . Notably, Khowaja and Salim demonstrated that CBI improved reading comprehension skills and overall learning in child with ASD [25]. Moreover, CBI has been linked to enhanced attention [26] , literacy skills [27], and learning rates [28] compared to non-CBI conditions [29].

In contrast, app-based treatments have shown mixed results. Whitehouse et al revealed that while these treatments were not superior to standard interventions, they did demonstrate benefits in specific developmental skills like visual reception and fine motor skills [30]. However, the attention span of young children to these apps is a concern which may lower the effectiveness of app- based treatment, with research indicating limited usage (2 minutes per day on average during the second 3 month). Novack et al extended these findings to older children, employing motivational strategies and a comprehensive app, “Camp Discovery,” which aimed at teaching receptive language skills for ASD child, including a variety lesson in a gameplay format, e.g., objects, emotions, sound discrimination, sentences etc [31]. Courses are designed for varying levels of complexity to address matching, sequencing, and/or receiving language skills The results showed the app facilitated gains in receptive language skills over a 4-week period. In addition, participants maintained the skills gained after a one-month delay without additional access to the app [31]. Despite its success, the study’s limited sample size and applicability to various ASD severities and impairments remain notable limitations.

App-based therapies offer cost-effective options and a platform for home-based caregiver programs [30]. This aligns with the last category, caregiver programs, which encompass parent-mediated interventions (PMIs) and parent-child interaction therapy (PCIT). These programs emphasize the interactions between parents and children, supported by therapists or applications, to foster effective parenting practices for ASD. Telehealth-based PMIs have demonstrated the potential to enhance parents’ information, satisfaction, and commitment [32]. Remarkably, PCIT resulted in reduced parenting stress, negative practices, and externalizing behavior problems [33]. The consistent involvement of parents in their child’s life leads to improvements in social skills, communication, general intelligence, work skill, play skill, vocabulary, motor skill and daily living skill, and overall development [32]. In conclusion, these internet-based interventions offer varied approaches to support ASD children and their families, showcasing potential benefits and highlighting the importance of personalized, well-rounded strategies.

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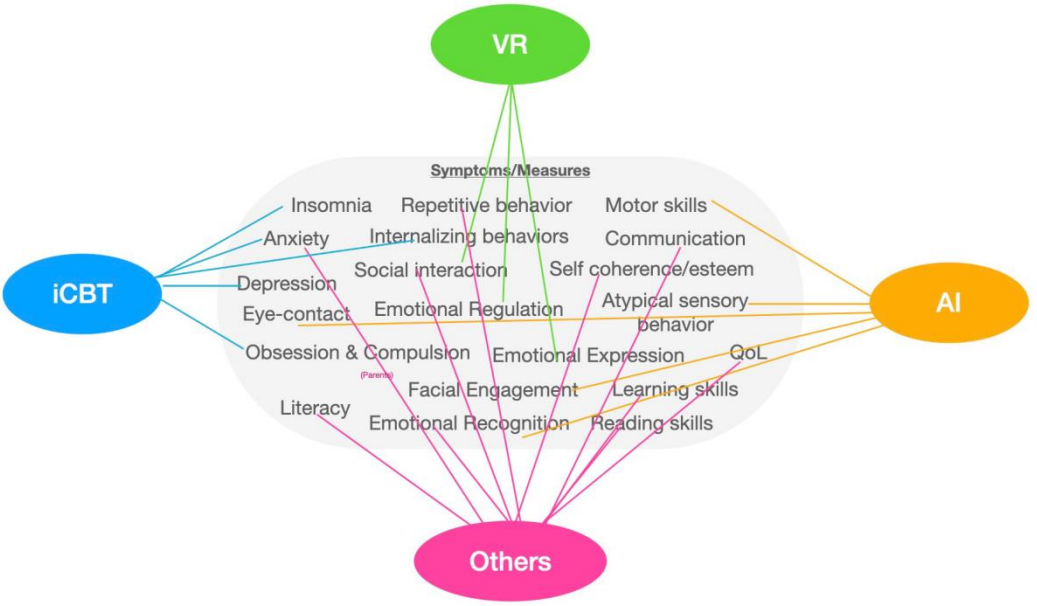

Figure 1. The internet-based treatment for ASD.

Note: There are 4 types of Internet-based treatments (ICBT, VR, AI, and others), each of which targets different ASD symptoms.

5. Discussion

This article presents an in-depth exploration of internet-based treatments as shown in Figure 1 (VR, AI and others) designed for Autism Spectrum Disorder (ASD), delving into their distinctive attributes and limitations. Drawing from a wealth of prior research, internet-based interventions emerge as particularly efficacious in the ASD domain.

Their efficacy extends to early detection and intervention, with a pronounced emphasis on enriching social competencies [19], satisfy educational needs [7](Strickland, 1997), bolstering cognitive acumen [32], refining reading comprehension proficiencies [25], honing communication skills [32], enhancing motor abilities [20,21], and augmenting emotion recognition aptitudes [16,18]. Additionally, noteworthy advancements manifest in the alleviation of parental stress and an enhanced overall quality of life through online therapeutic modalities [33]. The allure of these internet-based therapeutic pathways resides in their undeniable convenience and flexibility. The prospect of receiving therapeutic support within one's domestic haven or a familiar setting resonates significantly, particularly for ASD patients who often grapple with novel environments or transitions. The malleable scheduling options inherent to online therapy cater to demanding routines, offering solace to those beset by time constraints. This characteristic holds even more import for those ensnared by geographical barriers or other encumbrances impeding access to conventional, in-person therapy.

The internet-based treatments discussed are considered as a part of the complementary non-pharmacological interventions, in most cases, supplementing pharmacological interventions. One class of drugs of psychostimulants like methylphenidate are effective in improving comorbid symptoms but cannot intervene in core ASD symptoms including irritability, social withdrawal, and repetitive behaviors. Another common class, atypical antipsychotic drugs like risperidone and Aripiprazole, performs effects on easing ASD's symptoms of irritability and agitation in adults and as well as children [34]. In comparison to traditional treatments, internet-delivered therapy overcomes common treatment barriers like the lack of therapist resources, socioeconomic conditions, and geographical distance, enabling treatment in the period of the pandemic [35].

However, there are few limitations for online treatment. First of all, a discernible gap emerges in the exploration of internet-based therapy for adults and older ASD population. The existing studies have

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primarily revolved around game-based structures and simplistic skill acquisition approaches, potentially neglecting the diverse and nuanced needs of this specific demographic. Use computer programs, vr scenes, robots or apps to treat different ASD symptoms in the form of animations or cartoons, but this approach and treatment symptoms cannot be generalized to adults or older people with ASD. For adult patients, they need to learn more sophisticated knowledge to help them live and work better, such as understanding how emotions work, body movements and interacting with colleagues. Instead of just learning to recognize four emotions [18] , learn to tie your shoelaces [21]or improve your concentration [26]. Consequently, as the field of therapeutic interventions evolves, it becomes evident that there is a pressing need for a shift in focus toward developing internet therapy solutions catering specifically to the older ASD population.

Apart from the evidences listed above, there is still limited empirical research and evidence regarding the effectiveness of online threapy in treating ASD. While some studies have shown positive outcomes, the field is still relatively new, and there is a lack of long-term data on their effectiveness and any potential side effects or unintended consequences. In addition, it will be expensive to design a new programm that fit well with a specific needs ASD patients, making VR and AI less accessible to individuals and families with limited financial resources. Furthermore, it has been argued that online threapy lack of human interaction. Some argue that excessive use of AR technology in therapy may reduce the opportunities for individuals with ASD to interact with real people, potentially hindering social and communication skill development or it is a challenge the skill learned in the setted virtual enviroment would able to genralise to real-world situation. For those threapy focus on care-giver programmes, caregiver involvement in ASD treatment can be demanding and time-consuming. It often requires parents and caregivers to participate in numerous therapy sessions, practice techniques at home, and consistently provide support, which can be physically and emotionally exhausting, and might not statified most ASD families. Finally, internet-based threatment for ASD involoved in collecting sensitive or private datas, which may raise concerns about privacy and data security. Protecting this data and ensuring its confidentiality are important considerations. In addition, as the therapeutic landscape continues to evolve, practitioners must be mindful of the complex consequences of these emerging technologies. While Internet-based therapies offer a wealth of benefits, a sensible balance that balances their advantages with potential drawbacks, such as avoiding excessive use of web-based therapies that reduce opportunities for real-world communication, should guide their seamless integration into the ASD treatment framework.

In conclusion, internet-based treatment for Autism Spectrum Disorder (ASD) has demonstrated significant promise and effectiveness in providing support and intervention for individuals with ASD. This approach offers a convenient and accessible means of reaching out to a wide range of patients, delivering specialized therapies, and enhancing the overall quality of life for those on the spectrum. However, it is important to acknowledge that there are certain limitations associated with internet-based treatment for ASD that must be carefully considered. Internet-based treatment can be a valuable tool in the overall management of ASD, serving as a complementary therapy alongside traditional interventions such as drug therapy or in-person behavioral therapies. This combined approach can provide a more holistic and tailored approach to address the diverse needs of individuals with ASD. In summary, while internet-based treatment for ASD offers numerous benefits, it is essential for patients, caregivers, and healthcare providers to collaborate in making informed decisions about the most appropriate treatment strategy. By doing so, we can harness the advantages of internet-based treatment while ensuring that individuals with ASD receive the comprehensive and individualized care they require.

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References

[1] Rauschenberg, C., Schick, A., Hirjak, D., Seidler, A., Paetzold, I., Apfelbacher, C., Riedel-Heller, S. G., & Reininghaus, U. (2021).

[2] Rosen, C. S., Glassman, L. H., & Morland, L. A. (2020). Telepsychotherapy during a pandemic: A traumatic stress perspective. Journal of Psychotherapy Integration, 30(2), 174–187. https://doi.org/10.1037/int0000221

[3] Landry, S. H., & Loveland, K. A. (1988). COMMUNICATION BEHAVIORS IN AUTISM AND DEVELOPMENTAL LANGUAGE DELAY. Journal of Child Psychology and Psychiatry, 29(5), 621–634. https://doi.org/10.1111/j.1469-7610.1988.tb01884.x

[4] Gillespie-Lynch, K., Kapp, S. K., Shane-Simpson, C., Smith, D. S., & Hutman, T. (2014). Intersections Between the Autism Spectrum and the Internet: Perceived Benefits and Preferred Functions of Computer-Mediated Communication. Intellectual and Developmental Disabilities, 52(6), 456–469. https://doi.org/10.1352/1934-9556-52.6.456

[5] Jordan, C. J., & Caldwell-Harris, C. L. (2012). Understanding Differences in Neurotypical and Autism Spectrum Special Interests Through Internet Forums. INTELLECTUAL AND DEVELOPMENTAL DISABILITIES, 50(5).

[6] Mak, G., & Zhao, L. (2023). A systematic review: The application of virtual reality on the skill-specific performance in people with ASD. Interactive Learning Environments, 31(2), 804–817. https://doi.org/10.1080/10494820.2020.1811733

[7] Strickland, D. (1997). Virtual Reality for the Treatment of Autism.

[8] Lubar, J. F. (1991). Discourse on the development of EEG diagnostics and biofeedback for attention-deficit/hyperactivity disorders. Biofeedback and Self-Regulation, 16(3), 201–225. https://doi.org/10.1007/BF01000016

[9] Simões, M., Bernardes, M., Barros, F., & Castelo-Branco, M. (2018). Virtual Travel Training for Autism Spectrum Disorder: Proof-of-Concept Interventional Study. JMIR Serious Games, 6(1), e5. https://doi.org/10.2196/games.8428

[10] Ross, V., Cox, D. J., Reeve, R., Brown, T., Moncrief, M., Schmitt, R., & Gaffney, G. (2018). Measuring the attitudes of novice drivers with autism spectrum disorder as an indication of apprehensive driving: Going beyond basic abilities. Autism, 22(1), 62–69. https://doi.org/10.1177/1362361317735959

[11] Burke, S. L., Bresnahan, T., Li, T., Epnere, K., Rizzo, A., Partin, M., Ahlness, R. M., & Trimmer, M. (2018). Using Virtual Interactive Training Agents (ViTA) with Adults with Autism and Other Developmental Disabilities. Journal of Autism and Developmental Disorders, 48(3), 905–912. https://doi.org/10.1007/s10803-017-3374-z

[12] Smith, M. J., Ginger, E. J., Wright, K., Wright, M. A., Taylor, J. L., Humm, L. B., Olsen, D. E., Bell, M. D., & Fleming, M. F. (2014). Virtual Reality Job Interview Training in Adults with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders, 44(10), 2450–2463. https://doi.org/10.1007/s10803-014-2113-y

[13] Liu, W., Li, M., & Yi, L. (2016). Identifying children with autism spectrum disorder based on their face processing abnormality: A machine learning framework. Autism Research, 9(8), 888–898. https://doi.org/10.1002/aur.1615

[14] Crippa, A., Salvatore, C., Perego, P., Forti, S., Nobile, M., Molteni, M., & Castiglioni, I. (2015). Use of Machine Learning to Identify Children with Autism and Their Motor Abnormalities. Journal of Autism and Developmental Disorders, 45(7), 2146–2156. https://doi.org/10.1007/s10803-015-2379-8

[15] Rubio-Martín, S., García-Ordás, M. T., Bayón-Gutiérrez, M., Prieto-Fernández, N., & Benítez-Andrades, J. A. (2023). Early Detection of Autism Spectrum Disorder through AI-Powered Analysis of Social Media Texts. 2023 IEEE 36th International Symposium on Computer-Based Medical Systems (CBMS), 235–240. https://doi.org/10.1109/CBMS58004.2023.00223

[16] Christina Whalen, Lars Liden, Brooke Ingersoll, Eric Dallaire, & Sven Liden. (2006). Behavioral Improvements Associated with Computer-Assisted Instruction for Children with Developmental Disabilities.https://psycnet.apa.org/fulltext/2014-51874-003.html

[17] Jaliaawala, M. S., & Khan, R. A. (2020). Can autism be catered with artificial intelligence-assisted intervention technology? A comprehensive survey. Artificial Intelligence Review, 53(2), 1039–1069. https://doi.org/10.1007/s10462-019-09686-8

[18] Silver, M., & Oakes, P. (2001). Evaluation of a New Computer Intervention to Teach People with Autism or Asperger Syndrome to Recognize and Predict Emotions in Others. Autism, 5(3), 299–316. https://doi.org/10.1177/1362361301005003007

[19] Farhan, S. A., Rahman Khan, Md. N., Swaron, M. R., Saha Shukhon, R. N., Islam, Md. M., & Razzak, Md. A. (2021). Improvement of Verbal and Non-Verbal Communication Skills of Children with Autism Spectrum Disorder using Human Robot Interaction. 2021 IEEE World AI IoT Congress (AIIoT), 0356–0359. https://doi.org/10.1109/AIIoT52608.2021.9454193

[20] Palsbo, S. E., & Hood-Szivek, P. (2012). Effect of Robotic-Assisted Three-Dimensional Repetitive Motion to Improve Hand Motor Function and Control in Children With Handwriting Deficits: A Nonrandomized Phase 2 Device Trial. The American Journal of Occupational Therapy, 66(6), 682–690. https://doi.org/10.5014/ajot.2012.004556

[21] Moorthy, Ramya. S., Vigneshwaran, G., Iyer, A. R., & Pugazhenthi, S. (2016). Mechatronic-shoe kit for training children with ASD in enhancement of psychomotor and daily life skills. 2016 International Conference on Robotics: Current Trends and Future Challenges (RCTFC), 1–6. https://doi.org/10.1109/RCTFC.2016.7893417

[22] So, W.-C., Wong, M. K.-Y., Lam, W.-Y., Cheng, C.-H., Ku, S.-Y., Lam, K.-Y., Huang, Y., & Wong, W.-L. (2019). Who is a better teacher for children with autism? Comparison of learning outcomes between robot-based and human-based interventions in gestural production and recognition. Research in Developmental Disabilities, 86, 62–75. https://doi.org/10.1016/j.ridd.2019.01.002 Strickland, D. (1997). Virtual Reality for the Treatment of Autism.

[23] Escobedo, L., Ibarra, C., Hernandez, J., Alvelais, M., & Tentori, M. (2014). Smart objects to support the discrimination training of children with autism. Personal and Ubiquitous Computing, 18(6), 1485–1497. https://doi.org/10.1007/s00779-013-0750-3

[24] Kyle Higgins & Randall Boone. (1996). Creating Individualized Computer-Assisted Instruction for Students with Autism Using Multimedia Authoring Software. https://journals.sagepub.com/doi/epdf/10.1177/108835769601100202

[25] Khowaja, K., & Salim, S. S. (2013). A systematic review of strategies and computer-based intervention (CBI) for reading comprehension of children with autism. Research in Autism Spectrum Disorders, 7(9), 1111–1121. https://doi.org/10.1016/j.rasd.2013.05.009

[26] Moore, M., & Calvert, S. (2000). Brief Report: Vocabulary Acquisition for Children with Autism: Teacher or Computer Instruction. Journal of Autism and Developmental Disorders, 30(4), 359–362. https://doi.org/10.1023/A:1005535602064

[27] Basil, C., & Reyes, S. (2003). Acquisition of literacy skills by children with severe disability. Child Language Teaching and Therapy, 19(1), 27–48. https://doi.org/10.1191/0265659003ct242oa

[28] Massaro, D. W., & Bosseler, A. (2006). Read my lips: The importance of the face in a computer-animated tutor for vocabulary learning by children with autism. Autism, 10(5), 495–510. https://doi.org/10.1177/1362361306066599

[29] Hobson, R. P., Lee, A., & Hobson, J. A. (2010). Personal Pronouns and Communicative Engagement in Autism. Journal of Autism and Developmental Disorders, 40(6), 653–664. https://doi.org/10.1007/s10803-009-0910-5

[30] Whitehouse, A. J. O., Granich, J., Alvares, G., Busacca, M., Cooper, M. N., Dass, A., Duong, T., Harper, R., Marshall, W., Richdale, A., Rodwell, T., Trembath, D., Vellanki, P., Moore, D. W., & Anderson, A. (2017). A randomised controlled trial of an iPad-based application to

DOI: 10.54254/2753-8818/46/20240666

complement early behavioural intervention in Autism Spectrum Disorder. Journal of Child Psychology and Psychiatry, 58(9), 1042–1052. https://doi.org/10.1111/jcpp.12752 W

[31] Novack, M. N., Hong, E., Dixon, D. R., & Granpeesheh, D. (2019). An Evaluation of a Mobile Application Designed to Teach Receptive Language Skills to Children with Autism Spectrum Disorder. Behavior Analysis in Practice, 12(1), 66–77. https://doi.org/10.1007/s40617-018-00312-7

[32] Yosep, I., Prayogo, S. A., Kohar, K., Andrew, H., Mardhiyah, A., Amirah, S., & Maulana, S. (2022). Managing Autism Spectrum Disorder in the Face of Pandemic Using Internet-Based Parent-Mediated Interventions: A Systematic Review of Randomized Controlled Trials. Children, 9(10), Article 10. https://doi.org/10.3390/children9101483

[33] Ros-DeMarize, R., Boan, A., Bradley, C., Klein, J., & Carpenter, L. (2023). Tele-PCIT: Initial Examination of Internet Delivered PCIT for Young Children with Autism.Child Psychiatry & Human Development. https://doi.org/10.1007/s10578-023-01539-4

[34] Luby, J., Mrakotsky, C., Stalets, M. M., Belden, A., Heffelfinger, A., Williams, M., & Lubar, J. F. (1991). Discourse on the development of EEG diagnostics and biofeedback for attention-deficit/hyperactivity disorders. Biofeedback and Self-Regulation, 16(3), 201–225. https://doi.org/10.1007/BF01000016

[35] Hedman, E., Andersson, E., Ljótsson, B., Andersson, G., Rück, C., & Lindefors, N. (2011). Cost-effectiveness of Internet-based cognitive behavior therapy vs. cognitive behavioral group therapy for social anxiety disorder: Results from a randomized controlled trial. Behaviour Research and Therapy, 49(11), 729–736. https://doi.org/10.1016/j.brat.2011.07.009