

Technology Effectiveness of Communication in ASD

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### Abstract

The paper aims to explore the effects of technology on communication strategies of pediatric individuals on the autism spectrum. The construct of autism spectrum disorder itself is a vast, wide spectrum, which includes aspects of autism that are under-researched. Research focuses on the different levels of functioning within the spectrum. The different levels of functioning distinguish developmental abilities, strengths, and limitations in these individuals, and how they may benefit or be disadvantaged from the use of technology. The paper analyzes the effects of technology on children on the spectrum, in addition to focusing on the effects of technology on the specific level of functioning, which will overall determine the efficacy of technology.

### Technology Effectiveness of Communication in ASD

The purpose of the paper is to explore the effects of technology on communication skills in children with autism. Autism Spectrum Disorder, or ASD, is a concept used to describe individuals with a “specific combination of impairments in social communication and repetitive behaviors, highly restricted interests and/or sensory behaviors beginning early in life” (Lord et al., 2020). Each individual with ASD has a unique form of communication. While some are able to communicate effectively, most individuals with ASD face challenges with communication in social contexts (Denworth, 2018). In response to communication development, modern technology provides several, distinctive methods that aim towards improvement of communication in children with ASD. Some types of technology include tablet use, augmented reality, sensory boxes, computer applications, and several other interactive devices. In contrast, prolonged use of technology produces undesirable effects from the limited face-to-face communication, decreased attention span, and addictive property. Although the use of technology proves some adverse effects with communication skills, its diversity, constant developments, and quick adaptations promote positive interaction skills and communication in children with ASD.

#### **The Vast Technology Devices**

Technology can be used in a multitude of ways that are beneficial to learning. Some of the different types of technology include tablet use, augmented reality, and advanced interactive devices to promote collaboration skills and support communication development. Colorful, animated videos quickly grasp the child’s attention, which lures the individual to continue scrolling through to search for more videos. Moreover, the animated videos contain vast information that can be pertinent to the child’s developmental age. Technology can also be used

as a communication device, as there are several applications through technology that are user-friendly for individuals who are non-verbal.

### **Tablet Use**

Perhaps the most common type of technology use is through the use of tablets and iPads. According to research, tablets provide great visualization, creativity, and various intervention programs that aid in communication development (Yavich & Davidovich, 2019). In addition to the purpose of tablet use, several companies have developed applications with easy accessibility, which serve the purpose of communication assistance in children with ASD. Some of the intricately designed applications consist of StoryTable, GoTalk Now, and the TOBY software.

A research article by Yavich and Davidovich explores the effects of iPad use in children with ASD by determining the ability to acquire knowledge, developing communication and social skills, by detecting the presence of negative effects of prolonged technology use. The article argues that iPad use is beneficial because of several factors, ranging from easy accessibility, mobility, meaningful feedback, high quality, as well as the various applications that can be easily installed in the device. Additionally, iPad use allows for an easier understanding between teachers and students by detecting their behavior changes throughout the study. iPad use showed a remarkable enhancement in behavior, as students with ASD showed promising signs of attentiveness towards their teacher. Their improved changes in behavior include looking towards the front of the classroom, making eye contact with the teacher, engaging in a task without becoming diverted, and sitting in place. The use of iPads also aided in social development because it showed the ability for autistic children to share and take turns in application games (Yavich & Davidovich, 2019). Given these points, the use of iPad in the classroom allowed students to engage in communication, focus in the classroom, and practice sharing with other

peers. These several benefits of iPad use show promise with technology use because it aids the communication skills in children with ASD as well as enhances the ability to learn and focus in the classroom. Moreover, according to the article, iPad use not only benefits the students with ASD, but it also helps the teachers understand how to communicate whether the student is verbal or nonverbal. Overall, Yavich and Davidovich's article provides several positive aspects of technology use and its many benefits to the development of interaction in children with ASD.

Similar to tablet technology is a new intervention program called StoryTable, which consists of a collaborative narrative, multitouch tabletop interface, and enhanced social interaction for children with HFASD, or high functioning autism spectrum disorder. A research study conducted in 2016 examines the usefulness of StoryTable. Fourteen boys ages 7 to 12 participated in the study, in which their interactions were video-recorded and analyzed to ascertain how often they exhibited positive and negative social interactions including collaborative play, or the Friendship Observation Scale (FOS). The technology involved was a large tabletop display with multimedia, including elements of touch, sound, and vision. These elements engaged group work, increased collaboration and coordination, and provided several forms of expression between the individuals. Results from the study illustrate that social interactions and collaborative play were significantly improved; additionally, the results were enhanced through computer-related activities.

All in all, the results suggest that social interaction of children with HFASD are further enriched with technology because of the increased collaboration (Gal, Lamash, Bauminger-Zviely, Zancanaro, & Weiss, 2016). The StoryTable multitouch tabletop surface is similar to the iPad use because of the enhanced social interaction and improved collaborative play. Moreover, this study promotes forms of expression to be made by children with high functioning ASD,

which also aid in their communication skills. However, compared to the first article, StoryTable is focused towards supporting communication skills in children with high functioning ASD rather than all children with ASD. One could question the efficacy of StoryTable on children on the spectrum who are not considered to be high functioning, but further research is required. In short, both research studies both support technology use in communication development of children with ASD.

Compared to the multitouch tabletop surface that iPad use and StoryTable consist of, the GoTalk Now application combines an alternative approach to the challenging behaviors in children with ASD. A research in 2019 explores the effects of functional communication and approaches to challenging behaviors regarding two young children with ASD using a specific application on the iPad called GoTalk Now™. GoTalk Now™ investigates a concept called functional communication training, or FCT, which is a process that uses functional assessments to determine anticipated challenging behaviors and teaches new, alternative behaviors as a communicative response. Challenging behaviors could be expressed aggressively, self-injurious, or disruptively. These behaviors include hitting, pushing, head banging, and or crying. The two individuals in the study, ages 5 and 6 years old, were required to meet a certain criterion to be involved in the study: both were required to remain in their classroom program for at least half a year and produced fewer than 20 one- and two-syllable words. Apart from meeting the criteria, the two individuals also required verbal prompting. They were introduced to the application called GoTalk Now™, which generates speech output when touching a corresponding picture that expresses simple statements such as “I want iPad” and “I want book.” The simple statements acted as a bridge of understanding between the research participants and their teachers. In essence, the participants quickly learned the meaning behind the two simple

statements because after expressing them, an iPad or a book was given to the children. As the children utilized and demonstrated progression with the GoTalk Now™ application, the more phrases became unlocked, which also aided in their communication development.

Conclusively, the results of the study displayed success with developing communication skills in children with ASD. Additionally, the iPad application decreased the children's challenging behaviors and required minimal prompting (Muharib, Correa, Wood, & Haughey, 2019). The application featured functional communication training, which is an additional technological aspect of the study, as it helped children with ASD find alternative and healthy ways to communicate. Furthermore, the simple statements that were developed by the application served as another communication strategy. In comparison to the general iPad use and StoryTable, GoTalk Now shows further technological advancement; yet, all of the uses of technology show progression with communication development and also display success with use, supporting the use of technology in children with ASD.

Finally, the last aspect of tablet technology is related to the visual motor, imitation, language and social skills and children with ASD in Western Australia. The research conducted regards an application tested called the TOBY app, which determines effectiveness of social skills in children ages 2 and 6 with ASD. The Therapeutic Outcome by You, or TOBY, application uses principles from Applied Behaviors Analysis (ABA) and aims to improve four major skills: visual motor, imitation, language, and social skills. The application functions by presenting options of tasks that children with ASD can attempt to accomplish. In addition to presenting several tasks for the children, the application monitors progression of their skill development. According to the study, 59 participants received a baseline assessment prior to a randomized selection of individuals who were able to start the TOBY program right away, while

those who were not randomly selected were assigned to the waitlist. Results from the data show that there were no significant differences between a child using the program immediately apart from the individuals using the program from the waitlist. Furthermore, conclusive data displayed significant improvement with visual reception, fine motor, expressive and receptive language, and social and speech improvements, suggesting that the TOBY app provides beneficial communication development in children with ASD (Parsons, Cordier, Lee, Falkmer, & Vaz, 2018).

All four research articles related to tablet use and application displayed improvement with communication development in children with ASD. The research participants were spread throughout the spectrum, as one of the studies were aimed towards children with high functioning ASD. Moreover, the research participants ranged from both hemispheres, with a majority of research conducted in the United States, and one research in Western Australia. While each article encompassed its own designed application, all of the results show remarkable improvement with communication, behavior, and language development in children with ASD. Overall, the four research studies regarding tablet expenditure support technology use to enhance communication skills in children with ASD.

### **Augmented Reality**

As noted with the positive impact of tablet use on communication development, other types of technology have been designed for the purpose of aiding children with ASD. Augmented reality is a new, emerging technological tool with several purposes. One recent development of augmented reality is geared towards educational purposes, including the enrichment of communication techniques in children with ASD. Some of the main benefits of augmented reality incorporate the ability for individuals to utilize the digital tools and electronic



media, show preference for standardized and predictable interactions, enjoy elements of game-like simulations, and/or favor computer-generated speech. Since augmented reality is a relatively new concept, continuous research is necessary to determine the accuracy and efficacy.

Nonetheless, two research studies explore the effectiveness of augmented reality regarding communication development in children with ASD.

The first research article concentrates on internet-based and virtual reality (VR)-based treatment for children with ASD to provide a safe, controllable environment for social skill development. The study developed a training program with 72 children in Hong Kong to determine the efficacy of the VR. The VR technology proved promising results because of many reasons: low cost, mobility, and accessibility. The 72 children improved in their communication skills by greeting and speaking to their surrounding environment, including neighbors and relatives. Furthermore, the children with ASD engaged in two-way conversations and developed friendships within one another. The authors of the article believe that VR technology would benefit not only children with ASD, but also individuals with anxiety (Yuan & Ip, 2018). Ultimately, the virtual reality technology displayed a simulation in which children are able to practice their social skills. Since it is an augmented reality, the simulations were equipped to handle new scenarios and were flexible with the choices that the children made. The virtual reality's first priority was to maintain a safe environment, which proved success and promise. Additionally, the simulation in VR technology allowed the research participants to apply it to their personal lives, as evidenced by them practicing their social skills with their peers, family members, and surrounding neighbors.

Another form of augmented reality technology involves the use of smart glasses. Using a software called Empowered Brain, researchers detected the effectiveness of augmented reality,

or AR smart glasses, to aid in social and cognitive learning to children and adults with ASD. Similar to the study in Hong Kong, Empowered Brain was used as a headset and provided a simulated reality for children with ASD to practice their language development and practice approaching social settings. In contrast to the virtual technology in the Hong Kong study, Empowered Brain did not teach any additional communication skills to the children with ASD. However, Empowered Brain also did not develop any negative effects with modern VR headsets used by people with ASD because there were no behavioral problems of tantrums or meltdowns when asked to withdraw from the device (Sahin, Keshav, Salisbury, & Vahabzadeh, 2018, p. 3). While this version of augmented reality did not enhance the children's communication skills, it also did not provoke any negative behaviors upon returning the device, which is also a positive outlook of the study. Additionally, while the virtual reality technology in Hong Kong was deemed accessible and affordable, Empowered Brain failed to mention cost or accessibility.

Both studies displayed positive effects of technology because of its safe response from the research participants. As researched in the Empowered Brain study, the children did not regress to aggressive behaviors when withdrawn from the device, which leads one to assume how augmented reality could be a calming tool for children with ASD. Additionally, the virtual technology in Hong Kong showed some improvement with communication, as the research participants were able to practice their social skills to their surrounding neighbors and family relatives. Although augmented reality technology shows improvement with the behavior in children with ASD, the type of technology is relatively new and needs further research in order to be effective with communication development in children with ASD in the long-term.

### **Smartbox Interactive Device**

In contrast to tablet use and virtual reality technology, other types of technological advancements are for the benefit of children with ASD. SmartBox, more specifically, is an interactive device that increases concentration with tasks in children with ASD who are experiencing anxiety or panic attacks. The computer device allows students to establish control and aids them to practice communication skills in a lower stress environment compared to real environment. The device works towards maintaining the student's attention by implementing a calm-alert approach, stimulating the nervous system for peak attention and task performance. Overall, the device enhances the child's ability to register and familiarize themselves to sensory information. Some of the sensors incorporate a body sensor for detecting body and hand movement, chair or bed vibrator, and controls for the light, smell, and sound. The distinctive sensors work together to calm the child if he or she starts to feel agitated or uncomfortable. In addition, the sensors give the child full control of the stimuli, which obtains the child's attention and maintains focus in learning (Sual & Spaho, 2014, pp. 206-207).

Similar to augmented reality, the SmartBox interactive device allows individuals with ASD to practice social skills in a controlled setting. Compared to tablet use and augmented reality, however, the interactive device contains many sensors which work towards using a calm approach. This type of technology is an imperative tool because it can keep children with ASD composed during a stressful situation and the device can be manipulated into a comfortable environment for each individual. In either case, this type of technology does not directly engage in communication development in children with ASD; rather, SmartBox keeps the child in a calm, comfortable environment and enhances the concentrating ability. One could assume that this type of technology can be used as a stepping stool towards communication development—for example, this tool could be used first to ensure the child's comfort and attentiveness to learn.

Therefore, this type of technology is also beneficial towards the children with ASD because its calming approach ensures a safe, controlled environment for the child to learn in.

### **Computer Applications**

Computer applications also work towards improving communication skills for children with ASD. However, this field of technology is more under researched, and only has limited examples. One of the examples is the Internet of Things application, a website that works towards familiarizing common objects and machines, making it easier for children with ASD to connect to the objects and its relationship with one another. Internet of Things, or IoT, is a type of Internet application which develops communication between humans and machines. Through the use of human-machine and machine-machine communication, the website is designed to help the child with ASD be able to recognize events and changes in their surroundings and react automatically in an appropriate way.

Moreover, the internet application continuously organizes, molds, and adapts itself for easier visualization for the child with autism. The IoT shares information between objects in the environment to be easily simplified and understood by users, which makes it easier for children to connect living applications, products, energy, health, and social interaction (Sual & Spaho, 2014). In brief, the Internet of Things application is a simpler internet alternative which allows children with ASD to practice making connections within themselves and their surroundings. This internet application supports the development of communication because once the child with ASD is able to understand the relationship between the objects seen in the internet, then they are able to apply it to their learning and language. Similar to the SmartBox device, the application does not aid in communication skills specifically. On the other hand, the application is another educational tool for children with ASD to use if they need to improve in object

identification and improve on new vocabulary. Furthermore, this device would be used as a supportive search engine for children working on building relationships and connections between objects, and eventually work towards social interactions.

### **SIGUEME Intervention Technique**

Other technological interventions are combinations of technology use, in addition to human teaching and monitoring. One of the interventions is the SIGUEME Intervention, which is a program that helps children with ASD adjust to several scenarios that contain additional stimuli for practice. The intervention is a study with 125 children ages 3 and 16 years old with low-functioning ASD showing several impairments, including difficulties to recognize faces and objects. The research participants were to participate in a program called SIGUEME, which aims to improve the students' attention span, improve the student's recognition of object in visual representations, improve sorting abilities into separate sensorial or semantic categories, and enhance the student's interaction with adults and technological devices. The program is a technology-based application that is sensitive and personalized to user needs. Over time, evidence from the research concluded that the program SIGUEME positively improves attention, association/categorization, and interaction in low-functioning children with ASD. Some of the behaviors affected in the study contain improvements with listening to the adults, improvement with understanding the action-sound relationship, and the new behavior of looking at an adult to share the experience (Vélez-Coto et al., 2017).

Compared to tablet use, virtual technology, interactive devices, and computer applications, the SIGUEME intervention program is a combined technological effort that requires additional resources for its success. The program required several adults to work and track the students' progress, which indicates that additional resources and willing individuals

would be required should the program be used worldwide. Additionally, this program worked with children with low functioning ASD, compared to the other aspects of technology that was geared towards children with ASD or high functioning ASD. To summarize, this type of technology also provides support towards technology use in the development of communication in children with ASD.

### **Effectiveness of Technology Use in Children Throughout the Spectrum**

Numerous research articles explore the effectiveness of technology in relation to children throughout the spectrum, particularly children with low-functioning ASD and high-functioning ASD. A source defines children with low functioning ASD, or LFA, experience more difficulty regarding language, development, and communication. According to a source, children with LFA “typically present with restricted language, behavioral and emotional issues, severe memory impairment, poor adaptive behaviors, and limited social skills” (Walz & Bleuer, 2016, p. 5). In other words, children with low-functioning ASD face more challenges with communication, behavior, and recollection.

However, The SIGUEME Intervention worked towards improving the communication skills of children with low-functioning ASD and showed promise and some benefit (Vélez-Coto et al., 2017). On the other side of the autism spectrum, language and cognition appear to be more established in children with high functioning ASD. Children with high functioning ASD, or HFA, have “developed language and cognitive abilities, but experience social difficulties, and sensory and motor issues” (Walz & Bleuer, 2016, p. 6). The program StoryTable worked towards improving communication skills in children with high-functioning ASD, and the device also enhanced their development because of increased collaboration. While the research is new and emerging, the SIGUEME and StoryTable programs aim to benefit children throughout the

spectrum, and one is hopeful that continued research will be made to ensure the efficacy of these technological advancements.

### **Negative Effects of Technology Use in Children with ASD**

Some of the disadvantages to technology use involve regressive behavior when becoming withdrawn from the device. In example, when tablets were withdrawn from the child with ASD, behavior worsened, and their task performance decreased significantly. Additionally, in order for iPads to work properly, one must touch a specific and precise part of the iPad, which is shown to be difficult for children with ASD. Ultimately, iPad use showed significant improvements in social, developmental, academic, and communication skills; in contrast, iPad use also showed significant disadvantages that made it more difficult for children with ASD to perform tasks. (Yavich & Davidovich, 2019).

In addition, using augmented reality proved to have some negative effects. Some of the negative effects of technology in individuals with ASD are from the ability to develop problematic game use, becoming agitated or disruptive when attempting to withdraw from video games, and development of meltdowns and several behavioral dysregulations when attempting to withdraw them from smartphone and/or tablet use (Sahin et al., 2018). Overall, the results from each research does not show other negative aspects to technology use. However, all of the research articles explained the need for further study, including the long-term effects of technology use and its effects on communication skills.

### **Conclusion**

Although the use of technology proves some adverse effects with communication skills, its diversity, constant developments, and quick adaptations promote positive interaction skills and communication in children with ASD. In summary, the research shows an overwhelming

amount of benefit with technology use. Some aspects of technology helped with stimulation control; thus, improving attention span and concentration while keeping the children calm. Out of the researched articles, only two provided some negative effects of technology. Some of the negative effects of technology include aggressive behavior from withdrawal and technology malfunctions. The research is current, and the research is ongoing. Since the long-term effects of technology use are unknown, further research is needed to determine the effects of technology in a larger population, as well as the identification of any long-term advantages and disadvantages.



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