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Tablet Use and Social Skills in Autism Spectrum Disorder

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By

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DEDICATION

I dedicate this paper to my parents and siblings. Thank you for always supporting me, believing in me, and encouraging me. I could not have gotten to where I am today without you all.

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ABSTRACT

The use of computer tablets can be beneficial for communication deficits in Autism. Studies have shown that tablets can have positive effects on individuals with Autism Spectrum Disorder (ASD) who have trouble communicating and expressing emotions. A systematic review was conducted to examine if tablets helped people with ASD develop social skills and expression of emotion. A search was conducted through PubMed. From the initial search, 117 articles were found. Of these 117 articles, 10 met the criteria for review along with 2 additional articles found from an additional source. These 12 articles underwent a systematic review. Tablet applications and video modeling were used to help the individuals with autism be able to learn emotions, recognize facial expressions, and communicate how they are feeling. Studies showed positive results when using multiple apps and videos. Although many more studies should be conducted in order to further support these results, this systematic review elucidated positive outcomes of tablet use.

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LIST OF ABBREVIATIONS:

ASD   Autism Spectrum Disorder

ICTs   Information Communication Technologies

ID   Intellectual Disabilities

TD   Typically developing

ABC   Autism behavior checklist

AR   Augmented reality

VM   Video modeling

ARVMS   Augmented reality-based video modeling storybook

INTRODUCTION

Social skills play a significant role in the real world and are critical to have success in life. However, previous research has shown that individuals with Autism Spectrum Disorder (ASD) have deficits and/or delays in developing social skills. They tend to have trouble creating conversation, responding to situations in a social setting, and more (Reed et al., 2011). Because these individuals have difficulties in developing social skills, this is also affecting how they learn. There have been many studies that show how technology, tablets, and computer-based programs have been able to teach people with autism language and social skills. It is known that some individuals with autism have a hard time being social and rather are happiest when engaged with technology, which makes them feel safe and comfortable (Valencia et al., 2019). Mobile devices have the ability to teach individuals with autism social skills and expectations for certain scenarios such as "grocery store" (Withey, K. L., 2017). The purpose of this present study is to examine the impact that tablets and technology have on the development of social skills in individuals with Autism Spectrum Disorder.

While individuals with ASD have a hard time communicating with other individuals, they also have a hard time expressing their emotions and how they are feeling. Individuals with autism are known to find it hard to recognize emotions and facial expressions. They also have a difficult time understanding emotional cues like someone's body language and tone of voice. It is challenging for people with autism to demonstrate and manage their emotions. It is also understood to be hard for them to respond to peers and families emotions while also being able to understand them. The individuals may lack, or seem to lack, empathy with other individuals (Emotional development in autistic children, 2020).

Communicative difficulties were of most interest, because in our world today whereby it is very clear that children with autism have difficulty expressing their emotions and communicating with others, tablets have the ability to provide these individuals with so many resources. The number of interactive therapy tools, videos, pictures, and more provided through a tablet has been such a help to people with autism. Tablets can help engage and teach individuals with autism to participate in an activity so that they will be able to learn and demonstrate what they have learned to their teachers, family members, and friends.

Autism Spectrum Disorder is a developmental disability where individuals have deficits in social communication and interaction (Baio et al., 2018). These individuals sometimes have restricted interests (Lord et al., 2018). Individuals with ASD experience difficulties when it comes to social skills such as engaging socially, managing their temper, and social competence which leads these individuals to have a hard time making friendships and building relationships (Knott et al., 2006). As manifested by "spectrum", there are different severities when it comes to ASD. Some individuals may have very severe symptoms and therefore have a challenging time communicating their wants and needs, while other individuals only have mild symptoms where they do not experience the same amount of difficulty when communicating with people (Weitlauf et al., 2014). The outlook for people with autism is more positive than it was fifty years ago. Individuals are now able to read, speak, and interact in communities rather than having to be constrained (Lord et al., 2018). However, more knowledge is needed to understand how treatments can be effective for these individuals (Lord et al.,2018).

Social skills are forms of communication that are crucial to developing relationships which will then help one be successful in the future. Social skills include creating conversation, building friendships, and being kind to everyone. Social skills are one of the most essential skills

that young adolescents develop so that they can have success in their futures. Although most adolescents pick up social cues naturally, many do not (Lake, 2018). Individuals with ASD struggle with direct and indirect consequences dealing with deficits in social skills (White et al., 2007). People with ASD typically reject peer interaction and tend to be isolated from the social environment (White et al., 2007). Because individuals with ASD typically lack the development of social skills when others do, they typically have a hard time in school and the workplace. Also, their deficit in social skills leads to anxiety and other mental issues. There are many interventions in order to help people with ASD learn how to keep eye contact and create conversation (White et al., 2007).

Studies have been conducted to identify what helps individuals with autism develop social skills and the way that they interact with people (Grossard et al., 2017). Because the core symptoms of autism spectrum disorder are having trouble in communication, interacting with people socially, having trouble showing social emotion, and maintaining relationships, researchers have found that it has been beneficial in therapy to use Information Communication Technologies (ICTs) (Grossard et al., 2017). Individuals with autism enjoy spending time in virtual environments because they feel reassured and confident (Grossard et al., 2017).

Tablets have the ability to re-create many different situations that people experience in their everyday life. This helps the therapist to explore and prepare to share many different activities. Activities on the tablet have the ability for individuals with autism to request preferred stimuli by touching icons on the tablet and name pictures by touching icons (Kagohara et al., 2013).

Studies were conducted to show how targeting certain skills that individuals with autism lack using interactive therapy tools on technology will help them develop the social skills that

they need to be successful in life. There are now interactive therapy tools that are being played to target social skills in people with autism spectrum disorder. The skills targeted are empathy, problem-solving, enhancing collaborative skills, joint attention, symbol use, social understanding, and imitation (Grossard et al., 2017).

Technology devices have helped overcome impairments, including social interaction, in people with autism since the year 2000. There are over 30 tablet interactive therapy tools that aim to aid individuals with autism and they were each designed in a unique way to help each individual develop different social skills (Grossard et al., 2017).

Children with autism do not typically develop the same social skills that come naturally to other children at their age. Adults with autism are likely to overlook and miss the social signs that everybody else in the class understands. Technology has played a huge role in assisting individuals of all ages with autism to develop social skills. The use of videos, interactive therapy tools and pictures help individuals practice everyday situations and realize what they are doing well and what they can practice after seeing what went wrong. In this study, we constructed a systematic review to clarify if using different programs on an electronic device and tablet would help individuals with autism improve their expression of emotions and social skills.
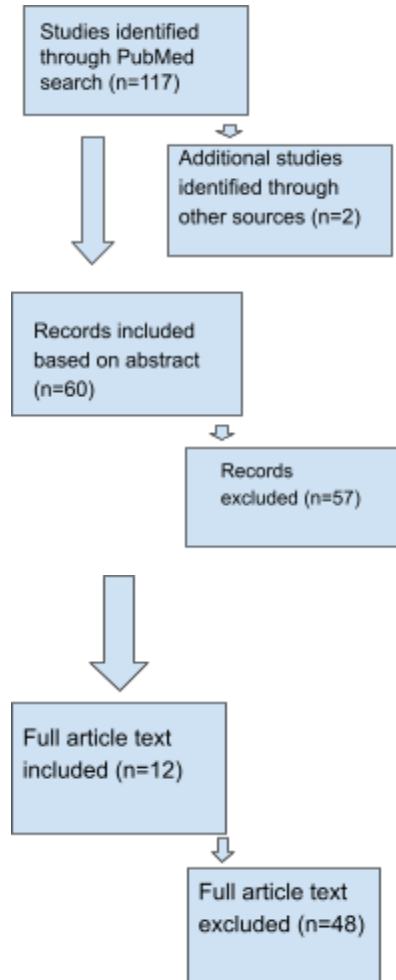
METHODS

In order to establish which studies were suitable for the systematic review, a PubMed search was conducted on October 9, 2019. The terms searched were [(((autism [Title/Abstract]) OR tablet [Title/Abstract]) AND communicate) AND emotions]. The initially retrieved publications were examined as the first step for potential inclusion based on their title and abstract. The remaining articles underwent a full-text review. Additionally, the references of each selected article were examined to identify other relevant sources. The first studies to be excluded were non-technology use studies. Following this, studies that did not include individuals with autism were excluded. Next, studies that did not test communication and social skills were excluded. Then, articles not testing expressions of emotions were eliminated. Following this, any review articles were eliminated. From the remaining articles, any article that included a test to see if individuals with autism were able to express their emotions using a tablet was selected for analysis. Two additional articles were found using google scholar. This process is shown in figure 1. Tables 2 and 3 show the name of the author, the year the study was written, the country it was written in, the clinical group and their age, the diagnosis of the individual, the area it targeted, the method, the results, and the classification.

RESULTS

As shown in Figure 1, the following results were obtained from the systematic review of 177 articles with 12 of the articles meeting the specific criteria for the study; 7 of the studies using applications, and 5 studies using virtual reality. It was shown through seven of the studies that tablets have the ability to help individuals with autism be able to express their emotions and communicate how they feel to others. Tablets have a positive impact on these individuals and make it possible to target certain areas that these individuals need to work on. In five of the studies, applications help people with autism communicate and express their emotions through sounds, videos, interactive therapy tools, and images. Tablets are easy to use and are not overly expensive. These tablets contain tools that focus on helping individuals with autism on many things. As shown in the results from the 7 dedicated applications, the individuals showed positive improvement while using the apps, their stress was reduced when using the dedicated application, and they were able to label the basic facial emotions equally to the typically developing children. In the studies conducted by Macpherson et al., Chen et al., Chen et al., and Akmanoglu et al., it was indicated that virtual-reality programs on tablets and computers have had a positive impact on individuals with autism. Teaching individuals with autism the names of facial expressions and what those emotions look like on a variety of faces is very effective when using video modeling. Individuals with autism are able to compliment people and they can differentiate facial expressions. Results from the expressing emotions through dedicated applications study are shown in Table 1. Results from the mixed-reality study are shown in Table 2.

Figure 1

Studies identified through PubMed search (n=117)

Additional studies identified through other sources (n=2)

Records included based on abstract (n=60)

Records excluded (n=57)

Full article text included (n=12)

Full article text excluded (n=48)

DEDICATED APPLICATIONS

In this study, dedicated applications are technological tools that help individuals with autism. These programs are provided through tablets, computers, and mobile phones.

Applications that are designed for people with ASD are used to help and test their skills when it comes to expressing and showing emotions. This study analyzes the electronic programs found to be most important.

The keywords used to search the most relevant studies on this technology on the internet were "autism," "expressing emotions," and "tablet". The first studies on dedicated applications began in 1995. Research on the topic has been continuing since. After 2007, research on dedicated applications began to increase and was the highest in 2010.

Studies were carried out to attest to the emotion recognition skills of individuals with ASD. Grossard et al. used a total of 31 serious interactive therapy tools in which 16 of those targeted emotion recognition. Many of the interactive therapy tools focus on recognizing emotions in pictures, audio recordings, video recordings, and drawings. Four of the interactive therapy tools also trained on producing emotions, often by having individuals mimic a model. Among them, only LifeIsGame (Fernandes, Alves, Miranda, Queirós, & Orvalho, 2011) includes emotion production exercises in a social context with no visual support. The results show that almost every individual showed good comprehension, enjoyment, and significant improvement.

Gay et al. described CaptureMyEmotion, an app available on smartphones and tablets. This app uses wireless sensors to capture data of facial expression recognition to provide a personalized way to help people with autism identify and understand their emotions. CaptureMyEmotion enables autistic children to capture photos, videos or sounds, and identify the emotion they felt while taking the picture. At the same time, a self-portrait of the child is taken, and the app measures the arousal and stress levels using wireless sensors. The app uses the self-portrait to provide a better estimate of the emotion felt by the child. This app has the ability to help autistic children understand their emotions.

School inclusion does not happen often for children with autism, because they struggle to manage emotions and maintain control of behaviors. Fage et al. assessed the benefits of their tablet-based application and recruited 3 groups of adolescents. Two of them were adolescents

with ASD. One group was equipped with our tablet-based application, the other was not. The third group consisted of adolescents with Intellectual Disabilities (ID), recruited in the same special-education classrooms as the equipped adolescents with ASD. There were a total of 50 students in the study ranging from 12-17 years of age. The first step taken was for the child to click on a picture to describe the emotion they were feeling at that specific time and then pick the intensity level of that emotion. Each intensity level is then matched with a coping strategy such as relaxing statements, pictures, video, and exit statements in which each has its own meaning.

Gordon et al. completed a study with a group of children with autism and IQ- matched typically developing (TD) children. These children were taught to produce the emotions of "happy" and "angry" with the FaceMaze game on the computer. This app has a recognition system that is able to analyze the individual's facial expressions in real-time. Before and after playing the Happy and Angry versions of the game, the children posed "happy" and "angry" expressions. FaceMaze states that the "happy" and "angry" expressions of the children with ASD were higher in quality than before the game. The expressions of the children with ASD after the game were rated equal in quality to the expressions of the typically developing children.

Petrovska et al. composed a study evaluating a computer-based intervention on emotion understanding in 32 children with autism spectrum conditions with and without an Intellectual Disability (ID) aged 7–15 years. There are six interactive therapy tools to provide learning and practicing emotions opportunities. The first game is meant for the child to match a facial expression to a verbal label. Four emotional faces will appear on the screen (happy, angry, sad, and afraid) and they will be given verbal instruction. The child is then to tap the face that matches the right emotion label. The second game has two pairs of facial features such as eyes and a mouth that are shown on the screen while the child is being instructed to make a face that

matches the face on the screen by dragging the facial parts to the correct area on the screen. In the third game, the child gets eight cards that have four pairs of different identities that produce the same emotional expression. The fourth game has four pictograms that represent basic facial expressions. The facial expressions appear on the screen and a verbal description is given with a visual prompt instructing the individual to pick the pictogram that depicts the right emotion label. In the fifth game, there is one emotional face presented on the screen while four emoticons are on the bottom. Without using verbal labels, the child has to match the pictogram to the emotional face. Lastly, the sixth game has a picture depicting an emotional situation that is shown on the screen with a short verbal explanation. The facial expressions are blurry or not visible. The child then has to pick the appropriate pictogram that shows what the protagonist is feeling.

Tanaka et al. used the emotion skills battery Let's Face It! This study contained 68 children with ASD and 66 neurotypical children. The children labeled social emotions such as happiness, anger, disgust, surprise, etc. shown on faces. The children with autism had worse results than the neurotypical children when naming happiness, sadness, disgust, and anger. It was found that children examined the facts and found that the children with ASD paid more attention to the mouth than the eyes, while neurotypical children paid more attention to the eyes than the mouth. The individuals with ASD knew how to label the basic facial emotions (with the exception of angry expression) evenly with the typically developing participants. The children with ASD had difficulty generalizing facial emotions across different identities. Findings from the *LFI!* emotion skills battery shows that participants with ASD were able to label the basic facial emotions (with the exception of angry expression) on par with age‑ and IQ‑matched TDC participants. However, participants with ASD were impaired in their ability to generalize facial emotions

across different identities and showed a tendency to recognize the mouth feature holistically and the eyes as isolated parts.

Torrado et al. analyzed the needs of individuals with autism and found a form of assistance in their emotional self-regulation. This will be able to ease their behavioral issues that threaten their mental health throughout their whole life. They argue that smart watches will be able to achieve the goal. Two individuals were involved with the experiment and they both showed different representative behavioral responses. Both of the individuals were able to engage in effective and self-regulation strategies through the smart watch. This helped them reduce their stress levels in just minutes.

Table 1- Dedicated Applications

Author	Year	Country	Clinical Group	Control Group	Age	Diagnosis	Area	Method	Results	Classification
Grossard et. al	2017	France	-	-	-	Autism	Social skills and emotion recognition	serious game applications	Children showed significant improvement using the apps	Social skills and imitation skills
Gay et al.	2013	Netherlands	-	-	-	Autism	Expression of emotions recognition	CaptureMyEmotion App	-	Communication and interaction
Fage et al.	2019	France	48 children	-	-	Autism and intellectual disabilities	Emotion regulation	Emotion-regulation app	It is an efficient support for adolescents with ASD to self-regulate their emotions	Communication and interaction
Gordon et al.	2014	USA	30 children with asd	23 typically developing	Mean 10.89	Autism and typically developing	Produce facial expressions	FaceMaze game on tablet	"Happy" and "angry" expressions of the children with ASD were higher in quality that before the game. The expressions of the children with ASD after the game were rated equal in quality to the expressions of the typically developing children	Communication, imitation skills, and interaction
Petrovska et al.	2019	-	32 children	-	7-15	Autism	Emotion recognition	Six emotion-recognition games	Strong positive effects were observed in emotion recognition from real face photographs and pictograms, as well as in understanding situation based emotion.	Communication, imitation skills and interaction
Tanaka et al.	2012	USA	68 children	66 children	Mean of 11.96	Autism	Perceive and interpret facial emotions	LetsFaceIt! to demonstrate their ability to name the facial emotions of happy, sad, disgust and surprise	Participants with ASD were able to label the basic facial emotions (with the exception of angry expression) on par with age- and IQ-matched TDC participants.	Communication and interpretation
Torrado et al.	2017	Spain	2 children	-		Autism	Self-regulate emotions	Smartwatch	Stress was reduced in minutes	Communication

Mixed reality makes it possible to develop and create situations in which real and computer-created elements are put together. Technology is a tremendous support tool for individuals with ASD to gain knowledge and new information. Mixed reality allows us to understand how children with ASD are challenged in different ways.

When searching the internet, the keywords "autism" "expressing emotions" and technology" was entered to find the studies most closely related to the topic.

Virtual environments have been studied to help learn certain skills such as expressing emotions. Macpherson et al. conducted a multiple baseline design and it was used to examine the effects of a portable video modeling intervention. This was delivered in the natural environment and focused on both verbal compliments and compliment gestures. The study consisted of five young children with autism. The children were observed while playing kickball with friends and adults. During the baseline, the children showed few compliment behaviors. During the intervention, a tablet was used to implement the treatment of the video modeling during the kickball game. When viewing the video, the verbal compliments given to the peers increased immensely. The children also demonstrated more variation in responses after looking at the videos. Some untrained activity occurred while some compliment gestures also occurred.

Vahabzadeh et al. conducted a study that explored the usefulness and effectiveness of Empowered brain and the intervention of computerized smart glasses. These were designed to act as a socio-emotional behavioral aid for individuals with ASD. The study was a two-part six-week process that involved four children with autism who attend a public grade school. The study consisted of an initial three-week feasibility stage which was then followed by a three-week controlled longitudinal efficacy stage. Both of the stages involved the use of the

socio-emotional intervention with smart glasses twice a day. In both the feasibility and efficacy stages, the children demonstrated developments (decreases) in irritability, hyperactivity, and social withdrawal. In the controlled efficacy stage, the children demonstrated lowered ABC (autism behavior checklist) subscale scores of 90% for irritability, 41.6% for hyperactivity, and 45.6% for social withdrawal. Improvement of hyperactivity and irritability was discovered during the efficacy stage. Educators rated the smart glasses as exceptional or vastly superior compared to other forms of technology.

Individuals with ASD may not recognize or discern important nonverbal behaviors. This causes them to ignore social cues and nonverbal gestures such as facial expressions. Chen et al. used an augmented reality (AR)-based video modeling (VM) storybook (ARVMS). This was used to enhance and gather the attention of the children with autism to nonverbal social cues. Augmented reality extends the social features of the store but restricts the attention of the child to the most prominent parts of the video. It is shown through evidence based research that augmented reality engages the children's attention. They used markerless natural tracking to instruct the children to understand and recognize the patterns as they concentrated on the visual image printed inside the story book and then continued their concentration to the animation of the story book. After the baseline, intervention, and maintenance test data was collected, the results showed that ARVMS effectively captivated and kept the attention of the children with autism to help them better understand the emotions and facial expressions of the characters in the story.

Chen et al. composed a study that tested the possibility of empowering three children with autism to become attentive to facial expressions that were observed in a school setting using augmentative reality through technology. The AR system implemented three-dimensional

animations of six basic facial expressions such as happiness, sadness, fear, disgust, surprise, and anger. This allows the children to practice social skills and emotional judgments. Based on the multiple baseline design across different subjects, the data expressed that the augmentative reality intervention is able to enhance the appropriate recognition and response to facial emotional expressions.

Akmanoglu et al. composed a study that aimed to consider the effectiveness of teaching children with autism how to name emotional facial expressions via video modeling. In order to teach the children how to name the emotions of happy, sad, scared, disgusted, surprised, feeling physical pain, and boredom, situations were made to lead to the development of facial expressions. Four children with autism participated in the study. They were ages 4, 5, and 6. Ten individuals participated in the research study; eight individuals participated in the display of the video modeling portion, and two individuals demonstrating the emotional facial expressions in the teaching and generalization sessions. The results of the study show that teaching the naming of emotional facial expressions to individuals with ASD is efficient. After the training ends, the children are still able to name these facial expressions. The individuals can generalize their skills that they learned from different simulation situations that were made by different materials in different environments. The mothers of the children, the teachers, and the post-graduate students mentioned how they have positive opinions relating to this study.

Table 2 - Mixed Reality Applications

Author	Year	Country	Clinical Group	Control Group	Age	Diagnosis	Area	Method	Results	Classification
Macpherson et al.	2015	USA	5 children	-	11, 9, 11, 10, 10	Autism	Verbal compliments and compliment gestures	Video- modeling	The children often demonstrated more than one compliment per opportunities and four of the five children demonstrated extensive response variation.	Communication, imitation skills and social interaction
Vahabzadeh et al.	2018	USA	4 children	-		Autism	Socio-emotional intervention	Smart glasses	Improvements (decreases) in demonstration in the feasibility in irritability, hyperactivity, and social withdrawal. In the efficacy stage, students demonstrated decreased ABC subscale scores of irritability, for hyperactivity, and for social withdrawal.	Communication and social interaction
Chen et al.	2016	Taiwan	6 children	-	Mean age: 11.53	Autism	Focus on specific nonverbal cues to prompt social-emotional reciprocity judgments	Video- modeling	Higher-level social skills and a greater ability to differentiate facial expressions depicting emotions	Social learning and imitation skills
Chen et al.	2015	Taiwan	3 children	-	Range from 10-13	Autism	Understand and compare the details of different expressions	Video- modeling	Retained the emotional expressions and social skills that they had learned	Social learning and imitation skills
Akmanoglu et al.	2015	Turkey	4 children	-	3 boys and a girl of the ages 4, 5, and 6	Autism	Naming emotional facial expression via video modeling	Video- modeling	Teaching the naming of emotional facial expressions to children with autism is effective	Communication and imitation skills

DISCUSSION

From the initial search, 117 articles were found. Of these 117 articles, 10 met the criteria for review along with 2 additional articles found from an additional source. It was shown that tablets and computers have a positive effect on individuals with autism. These electronic devices aid children in learning how to express and communicate their emotions.

Dedicated applications are provided through tablets, computers, and mobile phones to help individuals who have autism and struggle in certain areas. Certain applications are designed to help and test the skills of individuals with ASD when it comes to expressing and showing emotions. Five of the studies used applications on a tablet to help individuals with autism to be able to communicate and interact with others. Five of the seven studies using applications on a tablet showed an improvement in understanding and communicating their emotions so that they will be able to express how they feel.

Mixed reality is an excellent form of teaching as it creates situations in which real and computer-created elements are put together. This is a reliable way for individuals with ASD to view something in a different way which will help them understand better and gain new information. Mixed reality allows us to understand how children with ASD are challenged in different ways. 4 of the 5 studies used video modeling. It showed that learning, naming, and differentiating emotions are effective when using video modeling.

The articles examined in the paper were published between 2012 and 2019, which shows that this data was relatively recent and still applicable. One limitation of this analysis was including studies that were conducted on smart watches and smart glasses rather than including them in the excluded studies. Although it was shown that smartwatches and smart glasses improve communication, stress relief, and social interaction, it does not deal with using a tablet

to help individuals with ASD express and communicate their emotions. An interesting area to further investigate would be to conduct a personal study with individuals who have ASD in the Oxford, MS area. It would be interesting to watch for any improvements made over a 4 month period to see if these individuals improve their communication and expression of emotions using applications and video modeling. The remaining mystery would be to figure out if the tablet applications and video modeling helped the individuals communicate with others many years later without referring back to the apps or videos, such as communicating with friends, family, and co-workers. To help us better understand how tablets help individuals with autism, it is important to see how comfortable individuals with autism are when using a device and how many opportunities the tablet has to be able to keep individuals with autism interested in learning. Tablets can help us understand how people with autism work better when alone, and how the tools on the tablet can then allow them to then be social with others after teaching them ways to communicate and express emotions.

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