Analysis of Technology for Autistic Children: Technologies Created with Therapeutic Objectives may Need to Attain a High Level of Design & Function

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ABSTRACT

The capacity to capture diversity in the usage of commercial technologies by autistic children influence future learning and assist in the creation of new technologies. The survey data was gathered from parents (n =304) in the United States, and it contains information on people of varying ages and abilities. In our study, we discovered that the pattern of access and use was similar across age groups, but better reading and language ability was associated with the use of more devices and interfaces. The reported fear of technology was associated with a greater amount of time spent utilizing technology. Autistic youngsters make extensive use of mainstream technology for a wide variety of leisure activities. According to the findings, technologies created with therapeutic objectives in mind may need to attain a high level of design excellence in order to engage people.

Keywords: Autistic Children, Commercial Technology, Therapeutic Objectives, Leisure Activities

INTRODUCTION

Technology is widely used by autistic people for both recreational and academic reasons. They report high levels of usage of technology (apps, software, and online materials accessible via digital devices). The use of technology by autistic individuals who do not find a conventional survey design accessible—for example, young children or those with learning disabilities—is less well-documented. For example, digital devices that use touchscreen, physical, or whole-body interfaces have been widely available in the past decade, making technology more accessible to people from all backgrounds. It is possible to capture technology usage in a varied autistic population that includes younger children and people with learning disabilities by asking parents about how their children use these gadgets and what tasks they use them for.

In addition, parent surveys may be used to investigate the relationship between technology usage and parental views. At this point in time, the majority of research has focused on self-reporting by autistic adolescents and adults (Hedges et al., 2017; Mazurek & Engelhardt, 2013), though a recent study of parent attitudes in a small sample found that parents were enthusiastic but lacked knowledge about their children’s autism (Clark et al., 2014). In addition to external influences, it is probable that parental views about technology are both formed and shaped by their children’s usage of technology. According to Anand and Krosnick (2005), socioeconomic variables such as parent education and marital status influence the kinds of media that children in the household consume. Concerns felt by parents in general may
be heightened in the case of parents who have children who have been diagnosed with autism. As a result of autism’s distinctive social dynamics, including occasionally isolation, parents may be concerned that technology usage may distract from or replace “real-life” contact with their children (Valkenburg & Peter, 2009). It is possible that the existence of limited and repetitive behaviors indicates that the amount of time their kid spends using technology is a cause of special concern for parents, since technology usage itself may be considered restricted and by professionals (Mazurek et al., 2015).

Research has shown that digital technologies have the potential to improve learning and developmental areas related to autism, such as communication, social skills (Ramdoss et al., 2010), emotion detection (Berggren et al., 2017), and academic abilities (Ramdoss et al., 2010). A recent effort at a thorough meta-analysis revealed that there are just a few well-controlled studies on technology usage in an autistic sample, despite the fact that the quality of the evidence base is generally high in most instances (Grynszpan et al., 2013). We must overcome a number of basic barriers in the area in order to address this issue, including the rapid speed of innovation in commercial technology, which significantly surpasses the rate of production from university research. Moreover, we are aware that there is a systematic mismatch between those technologies for which independent effectiveness studies have been performed and those technologies that are commercially accessible (Kim et al., 2017). On the overall, the technologies that have the highest quality evidence are not always the technologies that customers may purchase directly from manufacturers. Because of this, it is necessary to investigate what technology autistic children and young people are really using in their homes. Knowing this is a critical first step on the road to establishing a solid evidence basis for the use of technology to help autistic people in the future.

Another unanswered issue in the area of technology for autism is the function of autism-specific design in the field of technology for autism. In recent years, a growing body of research has reported on best practices in design with and for autistic people (Fletcher-Watson et al., 2016) but there has been little work that explicitly links design elements with user experience or results. However, a significant pool of applications for mobile touchscreen devices that are explicitly promoted for users with autism exists in the commercial sector (Fletcher-Watson et al., 2016), but only a fraction of these apps have any scientific evidence to support their usage (Kim et al., 2017). It is unclear known if autistic individuals really utilize these autism-specific technologies, or whether they are equally—or perhaps more—engaged with “off the shelf” mainstream technology that are not autism-specific. Since there has been much discussion about making pieces of technology accessible to users with motor and learning difficulties, as well as creating content that is appealing to a broad spectrum of users including those with developmental delays (Fletcher-Watson et al., 2016), it is interesting to investigate whether and how these can be achieved by commercial technologies.

While the present research seeks to fill a number of information gaps about autism and technology, it also provides some statistics on technology usage since the widespread adoption of the iPad and other mobile touchscreen technologies. This is our overarching question: how do children with autism interact with technology in their homes? We can answer specific questions about the use of technology by children with autism by collecting information from parents about the devices, interface types, software, and functions that their children with autism use, as well as estimates of the amount of time spent on technology-mediated activities. As a starting point, do there seem to be any indications that children with autism often use autism-specific technology, such as augmented or alternative communication devices and technologies developed especially for autistic users? Second, what is the relationship between parental views about technology and their child’s reported technology usage, as well as the demographics of the sample?

**METHODS**

**Participants**

Parents of children with autism were asked to participate in an online poll. We included data from children who were presently on a waiting list for a diagnosis as well as those who had a secondary diagnosis such as Fragile X Syndrome. The final sample (n = 100) included respondents from California. Depending on their age, participants were divided into five groups: “preschool children” aged 5 years and younger, “children” aged 6-12 years, “teenagers” aged 13-17 years, “young adults” aged 18-25 years, and “adults” aged 26 and beyond.

In order to gather information on parent demographics and kid profiles, as well as information regarding technology usage at home and attitudes toward technology use, a survey in English was created. In order to determine reading level, parents were asked “can your kid read?” and then choose between the choices “yes,” “learning to read,” and “no” when asked “can your child read?” As part of the assessment, parents chose the most complex level of language achieved by their child from a list of options including babbling, word approximations, single words, two-word phrases, short phrases, multi-part sentences, wh-questions, complex grammar, appropriately using pronouns as well as fluent, adult-like speech. All versions of the survey were hosted on the website (http://www.surveymonkey.com).
Procedure

An online survey was sent out to parents of children with autism who were asked to provide information on their child’s usage of technology at home. The poll was available online for about 10 days. Data were downloaded in .csv file once the survey was completed and analyzed using after the survey was completed.

Analysis Methods

Data from the survey included both forced-choice responses (such as “select all the interface types that your child is familiar with”), 5-point rating scales (such as “rate how strongly agree/disagree with the statement I am concerned about how much time my child spends using technology” from strongly agree to strongly disagree”) and free-text sections (such as “list the top five apps/software/online platforms used by your child”).

The data was divided into five categories depending on the age of the child: “preschool children” between the ages of 5 and 6, “children” between the ages of 6 and 12, “teenagers,” between the ages of 13 and 17, “young adults,” between the ages of 18 and 25, and “adults.” To further refine our findings, we divided the sample into subgroups according to reading ability (fluent reader vs. learning vs. non-reader) and whether or not the child had a parent-reported learning impairment. To simplify things, verbal ability was divided into just two categories: “babbling, word approximations, single words, and two-word sentences” fell into this category, while “short phrases, multi-part sentences,” “whi questions,” “complex grammar, using pronouns appropriately,” and fluent adult-like speech fell into the “fluent” category. Because these group allocations are not based on age (e.g. “individuals with/without learning disability”), we use the word “person” when referring to them.

In order to investigate the relationships between technology usage and demographic variables, linear regression was employed, and Chi-Square tests were performed to look for multicollinearity. When there are gaps in the data, an analysis is performed on the information that is currently accessible, case by case (including demographic information, information about technology access, etc.). Researchers asked them for the names of the five most often used mobile applications, internet platforms, or software products by their children. A "top ten" list of the most commonly cited applications was created. It's important to know that certain applications were mentioned as a group, and we added up the answers identifying individual apps in that category to get an overall frequency count for all apps.

Parents used a series of closed-ended time-windows to describe how much time their kid spent each day using different types of technology (such as a tablet or a games console). Using a time frame of 30 minutes, data were transformed to numerical values and added together to produce an estimate of total technology time each day. These results were also utilized to estimate the number of minutes per day that each age group spent using a particular kind of gadget. There is a significant difference in the estimates because the number of respondents who had access to each sort of device was different for each estimate.

There were 10 questions in the poll regarding how parents felt about their children's usage of technology. A numerical scale of 1 to 5 was used to code the responses, with high scores reflecting a favorable attitude toward technology. There were three answer categories (agree, neutral, disagree—collapsing "strongly" at each extreme) when plotting the data for simplicity of visualization. Five relevant questions from the questionnaire were combined to produce ‘attitude score,’ which assessed attitudes toward technology rather than (for instance) available money for purchasing new technologies. The three remaining items (“I worry about how much time my child spends using technology,” “I have had problems with my child being obsessed with technology,” and “Technology prevents my child from interacting with other people”) were added together, and a regression was used to examine the relationship between attitude score and participant demographics. The final attitude score was calculated.

RESULTS

Devices

Table 1 lists the technological gadgets that parents' children have access to at home, as well as the devices that children can use on their own. The question about technology access did not specify a time frame, but the question about technology use was asked on any given day. Tablets and personal computers/laptops were the most often reported gadgets accessible to people of all ages.

Children's access to gadgets varied by age, learning disability (verbally fluent vs. delayed/learning), language ability (verbally fluent vs. delayed/learning), and reading level (fluent vs. learning vs. non-reader). It showed through an analysis of variance that there was a statistically significant variation in the number of devices used by age groups. According to the results, there was no significant difference in the average number of devices used by people with and without disabilities. Individuals who are more verbally fluent used more gadgets (mean = 4.45) than those who are less verbally fluent (mean = 3.25). And it showed that proficient readers (mean = 4.01) differed from those who were learning
to read (mean = 3.71) and those who couldn’t read. To find out how many devices proficient readers had access to, researchers looked at how many devices individuals who were learning to read or couldn’t read had access to.

Table 1: Technology that children access in their homes

<table>
<thead>
<tr>
<th>Device (%)</th>
<th>Preschool (n = 124)</th>
<th>Children (n = 140)</th>
<th>Teenagers (n = 18)</th>
<th>Adults (n = 22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad</td>
<td>58 (50.75%)</td>
<td>88 (61.25%)</td>
<td>8 (47.37%)</td>
<td>19 (42.86%)</td>
</tr>
<tr>
<td>Tablet</td>
<td>44 (40.3%)</td>
<td>45 (34.48%)</td>
<td>5 (23.68%)</td>
<td>13 (33.33%)</td>
</tr>
<tr>
<td>iPhone</td>
<td>24 (25.37%)</td>
<td>47 (35.63%)</td>
<td>6 (34.21%)</td>
<td>7 (19.05%)</td>
</tr>
<tr>
<td>Smartphone</td>
<td>34 (32.84%)</td>
<td>51 (38.12%)</td>
<td>8 (31.58%)</td>
<td>14 (35.71%)</td>
</tr>
<tr>
<td>PC</td>
<td>81 (67.91%)</td>
<td>109 (74.38%)</td>
<td>15 (62.79%)</td>
<td>25 (57.14%)</td>
</tr>
<tr>
<td>Apple Mac</td>
<td>6 (11.94%)</td>
<td>18 (17.5%)</td>
<td>2 (13.16%)</td>
<td>5 (14.29%)</td>
</tr>
<tr>
<td>Wii</td>
<td>42 (38.81%)</td>
<td>74 (52.5%)</td>
<td>8 (42.11%)</td>
<td>11 (28.57%)</td>
</tr>
<tr>
<td>Nintendo DS</td>
<td>51 (38.06%)</td>
<td>68 (48.75%)</td>
<td>7 (36.84%)</td>
<td>11 (28.57%)</td>
</tr>
</tbody>
</table>

Popular Software

When we talk about a technology’s ‘function,’ we mean the reason for which parents say their kid uses it. The poll provided parents with a series of closed-ended choices, enabling them to choose those that related to their kid. Reading, gaming, listening to music, surfing the web, and other activities were all options, as was an open-ended “other” option. According to frequency counts by device type for both children and adults, the most popular applications of technology were video games, YouTube, and music listening. This study found no significant variations in the use of technology by different age groups.

Technology for Autism

The following shows APPs most often mentioned by survey respondents.

1) Proloquo2Go

Proloquo2Go is a symbol based, augmentative and alternative communication (AAC) app. It is available on the iOS platform. It was created by Assistive Ware in April of 2009. The developers of the app say that the creation of the app was because of the fact that “Not being able to speak isn’t the same as having nothing to say.” The versatile app is meant for people from a range of abilities, all the way from severe cognitive disabilities to mild disorders. Its target audience is for those who are non-verbal from conditions such as autism, Down syndrome, cerebral palsy, and other special needs diagnosis. It also helps those with speech impediments such as apraxia and dysarthria. Although the app is used by both adults and children, the app previously had not offered text to speech in a child’s voice. However, the developers at AssistiveWare changed that in 2012. “About 60 percent of our users are under the age of 12 years old, so it only made sense for us to offer real children’s voices,” said David Niemeijer, founder and CEO of AssistiveWare, in a phone interview with AllThingsD. While AssistiveWare has no plans to offer the app on other plans, they provide reason for the decision. “We would rather focus our energy on creating the best product on one platform rather than spending resources on creating multiple versions,” said Niemeijer. He added that 70 percent of their customers bought the iPad just to use the application.

2) LetMeTalk

LetMeTalk, developed by Appnotize UG, is a free AAC app for the purpose of providing a voice for everyone. The app allows the user to sequence images in ways that create messages in the form of a sentence, with over 9,000 images from their database. It also allows the user to take images themselves and use them within the app, allowing for customizability and familiarity. The app can also be used in almost any situation, as it does not rely on internet connection or a mobile contract. The AAC platform helps those with various special needs, such as those on the autism spectrum, speech apraxia, Down syndrome, and other conditions that impede on speech. It also provides a plethora of useful features. It is available in 18 languages including English, Spanish, French, and Italian. This allows users to communicate to people all over the globe, helping those from all countries. It also has voice support for images and sentences, adding a new dimension to communication for non-verbal people. It also has an instant messaging system that allows for communication online between those using the app. The access of 18 different languages is especially important as it allows users to not only break the barrier of not being able to speak, but it also breaks the language barrier along with it. Users will be able to communicate with people from all over the world, something that very few people that are “verbal” are able to do. LetMeTalk truly helps anyone to talk with its understandable and simple platform.
3) **Endless Reader**

Endless Reader introduces “sight words” to young children who start to learn how to read, and the autistic who have learning and speech impediments. The “sight words” are words most commonly used in school and children’s books, making these words a “must know” set of vocabulary to read fluently. Endless Reader helps children learn words that are difficult to spell and words that cannot be expressed with pictures.

Endless Reader has a very interactive app, where there is a flashcard inside a monster’s mouth, and the student can scroll through the flashcard and pick which word to study. Then, a sentence with the selected word will be displayed, and by tapping the words, the students can hear each word pronounced. A small monster will then kick the words from the sentence out of place so that the words scatter. The student’s task is to put the words back together again to create the original sentence. Each movement comes with an animation and repeated pronunciation.

Some special features are:

- 6 words free trial without the purchase of any package
- Cute animations that make the learning process more engaging
- Word puzzles that help with spelling and sentence construction
- Ability to interact with the software at a student’s pace: there are no high scores and failures. This app was designed to give children education, not stress.

The school version provides 200+ words in each of the first two levels (Level 1 for PreK-K, Level 2 for K-2, and Level 3 for grades 2-3). In level 3, Endless Reader provides 118 more words. There is also a new version for teachers where students can also spell out the selected word.

4) **Otsimo**

Zafer Elcik is the Co-founder of Otsimo, an autism app that holds an augmentative and alternative communication (AAC) and multiple games. AAC provides a means of effective communication to those with speech impediments and those with autism spectrum disorder. Otsimo provides many learning packages: Premium with no ads, 100+ games, analytics, daily reports, recommendations, video modeling, and speech therapy skills, and Free with no ads and only some free games. With premium, there are voice based games that a child can access so parents can learn their voice and communication skills. There is also the option to receive speech therapy games from Amazon Echo devices. Otsimo was created because Elcik wanted to help his younger brother who was diagnosed with severe autism when he was just 2 years old. His younger brother had a hard time learning, but Elcik discovered he had a strong interest for smart devices: the brother’s attention span increased by 10 times each time he interacted with a device. Because of this discovery, Elcik gifted his brother an iPad. Because there were not many autism aiding apps and learning apps without harmful ads, Elcik was determined to create an app that provided a safe and effective education.

5) **Language Therapy for Kids**

Language Therapy for Kids - MITA is scientifically proven very effective in methods of teaching: in a 3 year study of 6,454 children affected with autism, those who trained with MITA scored an average of 2.2 times higher on a final test than those who did not study with MITA.

This app includes:

- unlimited language and cognitive exercises
- Activities such as identifying colors, time prepositions, subject/object, reading and writing, arithmetic, and much more.
- No Wi-Fi connection needed
- No Ads
- Available in 11 different languages: English, Spanish, Portuguese, Russian, German, French, Italian, Arabic, Farsi, Korean and Chinese.

MITA helps grow the learner’s imagination and language functions. As time passes, the exercises on the app will become more difficult, like assigning two tasks rather than one (ex. define the color and size). The problems will progressively ask for more as the child master’s a skill in that subject. MITA is designed for children and long term daily use. Its engaging features allow each child to stay more focused. This app is targeted towards children with language delay, SD, PDD, intellectual and developmental disability, Down syndrome, autism, and many more disorders that prevent a child from smooth communication.
**Time Spent in APP Activities**

Table 2 shows that tablets are used for much longer periods of time than most other technologies: on average, they are utilized for more than an hour each day. iPads (mean across groups = 80 minutes), other tablet brands (mean = 42 minutes), and PCs (mean = 61 minutes) were the most frequently utilized devices across all age groups. Children, adolescents, and young adults were apparently more likely than other age groups to use gaming devices, and they were more likely to use them for a longer period of time.

Table 2: Average time spent in technology-mediated activities by device

<table>
<thead>
<tr>
<th>Mean time* (hr with access)</th>
<th>Preschool (n = 124)</th>
<th>Children (n = 140)</th>
<th>Teenagers (n = 18)</th>
<th>Adults (n = 42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad</td>
<td>70.8 (68)</td>
<td>80.1 (98)</td>
<td>93.8 (18)</td>
<td>65 (18)</td>
</tr>
<tr>
<td>Tablet</td>
<td>38.1 (54)</td>
<td>48.1 (55)</td>
<td>67.7 (9)</td>
<td>82.3 (14)</td>
</tr>
<tr>
<td>iPhone</td>
<td>11.7 (34)</td>
<td>64.3 (57)</td>
<td>103.8 (13)</td>
<td>37.5 (8)</td>
</tr>
<tr>
<td>Smartphone</td>
<td>10.5 (44)</td>
<td>32.2 (61)</td>
<td>40.8 (12)</td>
<td>16 (15)</td>
</tr>
<tr>
<td>PC</td>
<td>56.2 (91)</td>
<td>80.9 (119)</td>
<td>118.4 (25)</td>
<td>38.3 (24)</td>
</tr>
<tr>
<td>Apple Mac</td>
<td>26 (16)</td>
<td>69.6 (28)</td>
<td>18 (16)</td>
<td>24.3 (12)</td>
</tr>
<tr>
<td>Kinect</td>
<td>10 (8)</td>
<td>0 (11)</td>
<td>3.33 (3)</td>
<td>0 (4)</td>
</tr>
</tbody>
</table>

The median amount of time each participant reported spending each day using technology was determined for each participant. Individual age, the presence of a learning disability, language ability, reading ability, and the number of devices that the individual can access were all considered in a regression study to determine the influence of these factors on the total amount of time that the individual reported spending with technology (Table 3). The literacy level of the person and the number of devices they had access to in the household were the most important predictors of time spent using technology: in both instances, greater levels predicted longer amounts of time spent using technology. The age of the person, the existence of a learning impairment, and the degree of language proficiency did not predict the amount of time spent using technology.

Table 3: Predictor variables for children’s reported time spent interacting with technology

<table>
<thead>
<tr>
<th>Predictor</th>
<th>b [LL, UL]</th>
<th>sr² [LL, UL]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>81.79 [-7.34, 170.93]</td>
<td>0 [-0.01, 0.01]</td>
</tr>
<tr>
<td>Child age</td>
<td>0.98 [-1.28, 3.24]</td>
<td>0 [-0.01, 0.01]</td>
</tr>
<tr>
<td>Child additional needs</td>
<td>15.17 [-27.65, 57.99]</td>
<td>0 [-0.01, 0.01]</td>
</tr>
<tr>
<td>Child language level</td>
<td>35.17 [-97.41, 27.08]</td>
<td>0 [-0.01, 0.05]</td>
</tr>
<tr>
<td>Child reading level</td>
<td>35.17 [-100.56, -34.53]</td>
<td>0 [-0.01, 0.01]</td>
</tr>
<tr>
<td>Number of devices accessed</td>
<td>42.68 [31.52, 53.84]</td>
<td>0.13 [0.07, 0.19]</td>
</tr>
<tr>
<td>Model fit</td>
<td>0.227** [0.14, 0.29]</td>
<td></td>
</tr>
</tbody>
</table>

*Indicates p < .05; ** indicates p < .01

When the b-weight is substantial, it implies that the semi-partial correlation is likewise significant. The semi-partial correlation squared (sr²) is represented by the symbol sr². Square brackets are used to denote the lower (LL) and upper (UL) bounds of a confidence interval, which are separated by a comma.

**Parent Attitudes**

On a 5-point scale from strongly disagree to strongly agree, parents were asked whether they were concerned about the amount of time their kid spent using technology. This was then compared to the overall amount of time reported by parents as being spent using technology. It was discovered that there was a significant connection between parents’ worry and the actual amount of time their kid spent using technology. Parents who were more worried about how much time their kid spent on technology indicated that their child spent more time on technology than those whose parents were less concerned. The poll consisted of 10 questions regarding parents’ perceptions of their children’s technology usage. On the basis of these three items (“I am concerned about the amount of time my child spends using technology,” “I have had problems with my child becoming obsessed with technology,” and “Technology prevents my child from interaction with other people”), the researchers created a scale that captured attitudes toward technology. Across the whole sample, the median attitude score was 9, with 3 denoting the most negative/worried attitude and 15 denoting the most positive/relaxing attitude.

With the help of a regression analysis, we were able to determine whether parent factors (parents’ age and age at which they left education) and child factors (child age, presence of learning disability, reading and language level, number of devices they accessed in the home) were associated with the amount of time that individuals reported spending with technology (see Table 8). When it came to parent attitudes toward technology, the sole meaningful predictor was the individual’s degree of reading: higher levels of reading were linked with greater time spent using technology.
DISCUSSION

It is the purpose of this article to investigate how children with autism utilize digital technology in their homes, as described by their parents, and to incorporate data from their grown-up offspring. What types of technology, interfaces and software were used as well as the amount of time spent on technology-mediated activities were investigated. We specifically asked whether parents would report high levels of use of autism-specific technologies, and whether they would report high levels of use of general technology. We also looked at the views of parents regarding their children’s technology usage, as well as the factors that may contribute to variation in these attitudes.

How Technology Is Being Used

Research has found that technology is a common recreational activity for autistic people (Fletcher-Watson & Durkin, 2015), and our findings support this finding by demonstrating that newer mobile and touchscreen technologies are being used by children from very young ages, as well as by those with a variety of language and reading abilities. Compared to youngsters with lesser reading and language skills, those with greater reading and language abilities allegedly had access to more gadgets, were more autonomous in their use of various interfaces, and spent more time interacting with technology. It was shown that people with learning disabilities were able to utilize a greater number of technological interfaces independently than those who did not have a learning problem. Interestingly, this was an unexpected finding, since it does not accord with other aspects of the profile, such as the fact that people with a learning impairment have fewer gadgets available to them and spend less time interacting with technology. The fact that parents spend time looking for a variety of alternative interfaces for their children when they are having difficulties using the mainstream interfaces such as the keyboard and mouse is one possibility for explanation. Parents of children with these characteristics may have been more engaged in teaching and supporting their child’s use of these interfaces, which may have been reflected in parental reports of skill development. Furthermore, as compared to adults, youngsters were found to use considerably more interfaces on their own. That adults continue to utilize technologies that were accessible to them as children and have not broadened the variety of interfaces available to them may be a contributing factor to this finding. It is also conceivable that our adult group includes a somewhat higher proportion of individuals with learning disabilities and other complicated requirements, given that we anticipate that these autistic people continue to live at home with their families. These findings also indicate to a complicated interplay between parental attitude, kid ability, age, and technology usage, which will need observational techniques and additional qualitative research to fully understand and investigate.

As previously stated, we continue to think that design particularly for children with autism offers advantages (Frauenberger et al., 2016), not the least of which is the ability to empower children via the design process (Frauenberger et al., 2013). Technological products are among the most popular things of particular interest among the autistic community; in fact, recent research has shown that these items of special interest are critical to the well-being of autistic individuals. The establishment of a scientific evidence basis for the technologies that are presently being used by children with autism is an essential future research area. There were many purposes of technology usage that were often mentioned, including digital gaming, YouTube, listening to music, and looking at or shooting photographs. Such functions, on the other hand, should not be immediately regarded as just amusement activities. Other research has indicated that children with autism may be better able to converse and play together while utilizing technology as opposed to their analogue counterparts, according to the findings of other studies (Farr et al., 2010). It will be necessary to do a more in-depth analysis of our qualitative survey data in conjunction with observational data in order to establish how our category definition of use manifests itself in more detail. Furthermore, such study should be cognizant of the fact that technology usage that seems to be non-functional may play an essential role in the lives of the person being examined. Some technological features may be calming or soothing, while others may offer essential cultural information that is needed for social interactions with peers.

The Attitudes of Parents

Parents who expressed worry about how much time their kid spent using technology did give greater estimates of that time. However, because of the dependence on parent-report data, it is difficult to interpret this finding. It is conceivable that parents who are worried about ‘screen-time’ exaggerate their children’s reporting of time spent on devices, or that parents who are less concerned underestimate their children’s time spent on gadgets. There was just one significant predictor of parents’ attitudes toward technology: the kid’s reading ability. No other factor related to either the parent or the child was a significant predictor of attitudes toward technology. When it comes to online or digital content, those who have better reading comprehension may be able to access a greater variety of resources and may be more autonomous in their pursuits, which may cause parental worry.

There are several drawbacks to this research, the most significant of which is that all findings are based on parent accounts of their child’s technology use. The statistics may be skewed due to parental preferences, especially in the
area of ‘screen-time,’ which has lately been a subject of discussion in the media. Without a more in-depth examination of cross-cultural variations in employment and socio-economic status, it is difficult to make sense of these results. Although we did not conduct any comparisons between our groups based on their resiencies or demographic background, we do believe that we have a decent representation of what might be inferred to be various socioeconomic and demographic backgrounds throughout the whole sample.

We were unable to draw comparisons across various days of the week in terms of technology usage. Children with and without autism have more access to technology on a normal weekend than they do during the week. We also did not conduct comparisons between groups of autistic and non-autistic people in terms of technology usage, despite the fact that previous studies have shown minimal difference between these groups, most notably in a large and representative sample. We believe that our results regarding the kinds of technology used by autistic individuals in the home have a variety of implications for design and future study. In the first place, the design of new technologies for autistic people must be competitive with, or at the very least equal to, presently existing technologies and applications, which we now know are routinely used by autistic individuals themselves.

The patterns of technology usage reported by parents of children with autism in this research do not seem to be significantly different from those that would be anticipated of a group of children who are not diagnosed with autism. Our research reveals that the most frequent uses of technology are for gaming, listening to music, watching movies, and doing schoolwork, and that the reported usage of autism-specific apps is minimal. According to our findings, parents are concerned about their children’s use of technology, especially in terms of the amount of time they spend on gadgets and the social implications of using technology. In order to further understand the nature of these issues, qualitative and observational techniques may be used in future study.

**References**


