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Effect of the use of an iPad on the attention span of a child with Smith Magenis Syndrome: A single case study

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Abstract

Aims: To assess the effectiveness of iPad use on the attention span of a child with Smith Magenis Syndrome ($n = 1$), compared to attention span while working on the same tasks manually. **Methods:** An AB design with a baseline and an intervention phase was used. Three manual tasks were chosen for the baseline, which matched the participant's intellectual age by the Early Intervention Method: a jigsaw puzzle (six pieces), a shape sorter, and matching pictures. These same tasks were performed on an iPad during the intervention phase. Six baseline and nine intervention phase films were included in the analysis. The 15 films were independently scored twice by two observers: once to observe the types of distractions that occurred (such as standing up from the chair, calling the teacher, or turning around on the chair), and a second time to measure the effective working time. **Results:** iPad use led to a 45% decrease in the number of total distractions. The effective working time improved by 8% and showed a more consistent range compared to working on tasks manually. While task enjoyment was not directly measured, the observers and teachers agreed that working on the iPad appeared to be more enjoyable. **Conclusions:** In this single case study the participant showed that in his case iPad use can be effective in decreasing his distractions and therefore can improve his attention span. Enjoyment was higher while working with the iPad than performing tasks manually. This technology could therefore create more learning engagement for the participant, which could positively impact his behavior. Further research into iPad implementation for children with intellectual disabilities, poor fine motor skills, and/or attention deficits is needed.

Keywords

iPad use, attention span, Smith Magenis Syndrome, intellectual disabilities, poor fine motor skills

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Introduction

iPad technology has undergone major development associated with its potential role in education since it was introduced in 2010. Tablets are often used in primary school education or in more advanced classes, and adaptive apps are frequently used to measure progress and create individualized approaches (Faber and Visscher, 2016). In addition to use in educational settings for typically developing children, the use of tablets and other technologies for children with disabilities is also an active area of research. Studies have shown that tablet use can be of added value to various populations including children with autism, ADHD, and/or intellectual disabilities in various areas and in various ways (Allen et al., 2016; Chmiliar, 2017; Coutinho et al., 2016; Den Brok and Sterkenburg, 2015; Kagohara et al., 2013; Wiley et al., 2014). For example, a large systematic review of 15 studies conducted by Kagohara et al. (2013) showed that the results are generally positive and that individuals with intellectual disabilities can be taught to use devices such as iPods, iPads, and iPhones for a variety of purposes and specifically for the enhancement of academic, communication, leisure, employment, and transitioning skills.

The use of these technologies in specialized childcare centers or schools in the Netherlands is increasingly common and the amount and variety of technologies is rapidly growing. The population in these facilities consists primarily of children with developmental delays (cognitive, physical, or both, and sometimes caused by syndromes), ADHD, autism spectrum disorders, or combinations of these (Meijer et al., 2010; Rutgers et al., 2019). Some of these children have a hard time focusing on individual tasks due to attention problems (Påhlman et al., 2020; Poisson et al., 2015; Sharma and Couture, 2014; Vasudevan and Suri, 2017). Attention seeking behavior is one of the most significant and challenging problems in Smith Magenis Syndrome (SMS) (Wilde et al., 2013), and there have been several studies describing cognitive and behavioral problems associated with SMS since the first description of the syndrome in the 1980s. SMS is a rare genetic syndrome with a prevalence of approximately 1/25,000 to 1/15,000 births (Greenberg et al., 1991; Laje et al., 2010) and is caused by a chromosome 17 p11.2 deletion (Greenberg et al., 1991; Laje et al., 2010; Smith et al., 1998) or, more rarely, by a mutation of the retinoic acid-induced 1 (RAI1) gene located on the same chromosome (Slager et al., 2003; Wilde et al., 2013). SMS is characterized by distinctive physical features, developmental delay (specifically disabilities in gross and fine motor skills), cognitive impairment, and behavioral abnormalities (Smith et al., 2001). Several studies also report sleep disorders, stereotyped behaviors, challenging behavior, impulsivity, hyperactivity and attention-seeking (De Leersnyder et al., 2001; Martin et al., 2006; Sloneem et al., 2011; Smith et al., 1998, 2001; Wilde et al., 2013). In addition, to the attention seeking behavior, the preference for adult attention can also be challenging for teachers (Wilde et al., 2013).

Children with SMS exhibit a wide range of cognitive impairments, with most functioning in the mild to moderate range of intellectual disability (Elsea and Finucane, 2009; Udwin et al., 2001). Children with SMS are often expected to attend a special school based on their intelligence, yet these children often experience problems at school because of their challenging behavior (Poisson et al., 2015; Wilde et al., 2013). If their attention span improved it could possibly influence their school performance in a positive way (Rabiner and Coie, 2000; Schmerse, 2020; Warner-Rogers et al., 2000). Although there are several ways to try to improve attention span such as sensory integration therapy (Ayres, 1972; Case-Smith et al., 2015) and the TEACCH method (Mesibov et al., 2005), we turned our attention to the literature on Smith Magenis Syndrome and their fascination for technologies. Several studies mention the focus SMS children apply to screens,

tablets, or computers (Dykens et al., 1997; Poisson et al., 2015; Smith et al., 1998). Dykens et al. (1997) report that long-term memory, computer skills, and perceptual skills were areas of strength in both child and adult samples, and note that children with SMS tend to be visual learners. Poisson et al. (2015) noted that the use of computers or tablets may be useful to reinforce learning in this population given their fascination with screens. The iPad is multi-functional and can be used in different ways and for different purposes including recreation, as an educational device, as a communication device, and it can be carried by a child for use at any time. Poisson et al. (2015) also stated that the use of sign language and total communication programs as adjuncts to traditional speech and language therapy appears to improve communication skills and also tends to positively impact behavior. These sign language and communication programs, next to educational- and recreational apps can be installed on an iPad, turning it into a multifunctional device for children with Smith Magenis Syndrome.

Wiley et al. (2014) reported that the researchers in her study were generally positive when considering the iPad as a learning tool in a class for children with disabilities, and their comments indicated positive results associated with increased attention to tasks. Other studies have also indicated the capacity for a tablet device to decrease non-compliant behavior and decrease the need for teacher support in classrooms for children with autism and/or developmental disabilities (Arthanat et al., 2013; O'Malley et al., 2013).

Besides their attention deficit, it is also known that most children with SMS have problems with their fine motor skills. The development of fine motor skills plays a role in the learning curve for typically developing children (Abdelkarim et al., 2017; Van der Felsa et al., 2015), from being able to assemble puzzles and beginning to color, and ultimately leading to writing. For example, if you are able to put a puzzle together, then you grow a step on the Early Intervention Method (Pieters and Treloar, 1995). If this does not work out due to poor fine motor skills, then it is also more difficult to progress cognitively to more difficult tasks, such as a more complex puzzle that requires more insight (Pieters and Treloar, 1995). Since children with SMS tend to have poor fine motor skills, the difficulty associated with learning these tasks could cause attention problems or problems with learning (Smith et al., 1998). Therefore, working with an iPad, which requires fewer fine motor skills, could reduce attention problems and stimulate working independently. Also, the direct feedback given by the iPad might reduce the need to ask for feedback from teachers, increasing the time spent performing the task and minimizing disruption to the group and the teachers, which may allow for participation in a special educational needs school.

Although several studies on the use of technologies in children with disabilities are available, which support the effectiveness of tablet technologies as a learning tool and/or adaptive device, none of them focus on how it affects the attention span. Therefore, the aim of this single case study was to determine the effect of iPad use on the attention span of a child with Smith Magenis Syndrome and severe attention span problems. The main research question was: Does the iPad use contribute to higher attention span compared to the attention span during similar manual tasks, performed by a child with SMS?

Method

Design

In this single case study we used an AB design with a baseline and intervention phase. The baseline consisted of manual tasks and an iPad was used to perform the tasks in the intervention phase. This

design is also known as the basic time-series design and is quasi experimental, which means that no type of randomization was used and no replication of the baseline and intervention phases was scheduled in the design (Kratochwill and Levin, 2014; Kratochwill et al., 2010). In single case designs it is recommended that there be a minimum of five data points in each phase (Kratochwill and Levin, 2014; Kratochwill et al., 2010). To improve the value of the study we decided to do seven baseline measurements, and nine intervention measurements as missing data may occur. As was expected, due to problems with one of the intervention films the final measurements were six baseline, and nine intervention measures. Similar conditions were used in the baseline and intervention phase: the participant was always in the same (test)place, same spot and with two or more children also present in the room. All the tasks (during baseline and intervention phase) were guided by his own teachers. There were no overlapping data points. There was only one measurement on one day, meaning that all measurements were done in 2.5 weeks. Outcome measures were total amount of distractions and effective working time, and the independent variable was the intervention with the iPad.

A qualitative semi-structured interview, which consisted of questions about the teachers experience of the participant's engagement, behavior and distractions moments during the baseline and intervention phase, was conducted by the first author with the teacher. Questions were for example: "What did you think of his posture and attention span during the manual tasks" and "How was this while working on the iPad?"

A consent form was obtained and the teacher read the report and checked it for accuracy.

Participant

Our participant is a 5-year old boy with Smith Magenis Syndrome. He lives at home and visits a specialized childcare center 5 days a week. He uses short sentences (three to four words), enjoys social interaction with adults and children, and is able to walk. He prefers social contact over playing on his own. An IQ test shows a SON-IQ (Tellegen et al., 1998) of 50 (developmental age 2 years and 5 months). The *DSM-5* states that an intellectual disability is considered to be approximately 2 standard deviations or more below the population, which equals an IQ score of about 70 or below (American Psychiatric Association, 2013). Most persons with SMS show a moderate intellectual deficiency, with an IQ between 40 and 54 (Dykens et al., 1997; Udwin et al., 2001), meaning our participant fits that profile. Both the childcare center and his parents would like him to attend a school for children with special educational needs, but the school rejected his admission due to his attention deficit. When working at a table with other children he spends more time looking at the other children, standing up from his chair, calling the teachers, or just looking around than working on his assigned tasks. The school will admit him if he shows that he can work independently, sit on his chair, and refrain from asking for support or approval from teachers. His parents provided written informed consent for his participation in this study, furthermore the participant was verbally informed of the study and asked if he wanted to participate. No medical ethical approval was required as it is a non-invasive study. Ethical approval was requested at the ethical team of Stichting Ons Tweede Thuis and permission was granted. This single case study was conducted according to the Ethical Principles for Medical Research Involving Human Subjects of the World Medical Association declaration of Helsinki (2013).

Intervention

First, we chose three manual tasks that the participant was currently working on in his program. These tasks were chosen by his teachers using the Early Intervention Method (Pieters and Treloar, 1995) and consisted of the following: a six piece puzzle, a shape sorter, and a set of matching pictures. The tasks were practiced two times 10 minutes with the participant in order to ensure that the tasks would not be completely unknown to him. We then searched the App store to find an application for similar tasks, and we purchased a paid version of the application (Bimiboo) to avoid advertisements popping up during use, which would cause distraction. We practiced the tasks with him on the iPad before starting the intervention phase. He was not initially skilled in using the iPad (swiping, touching, lifting the finger, navigating through the operating system, etc.), but his skills improved quickly and measurements began after three practice sessions of 10 minutes. The teachers were instructed on how to take the measurements and record movies. They were allowed to guide him as they always do when working with him, so they did not have to change their method. When he asked for or seemed to need help, they complied, and they tried to make him work as independently as possible. A setting similar to a classroom was re-created. Therefore some other children were present in the room while he was performing the tasks. We chose to not completely standardize this process because we wanted to see the results in a realistic situation. The number of children present varied because of the variation in their daily programs, but there were always at least two or more. It also differed what they were doing since every child has his own daily program. Since these children were not recorded on film, no informed consent was obtained for these children. The manual tasks were recorded until the participant had finished all three tasks, which were always performed in the same order. This was his usual method of working on tasks and the decision was made to maintain it during the study. After completing one task the participant was instructed to call for his teacher so the task could be checked before beginning the next task. The participant sat in a so called TEACCH corner during all manual and iPad tasks. TEACCH stands for Treatment and Education of Autistic and related Communication Handicapped Children, and is an internationally recognized treatment and support-modality for individuals of all ages with signs of autism spectrum disorder (Mesibov et al., 2005). The TEACCH corner is surrounded by walls so that the participant can focus on his tasks and this method was already in use to attempt to minimize his distractions. His manual tasks were sorted into three boxes marked with a pictogram attached to the box with velcro tape. The pictogram was taken off the box and stuck on a task strip before beginning each new task. During the intervention phase the participant was also seated in the TEACCH corner and was given the iPad. We instructed the participant to first complete the shape sorter on the iPad, after which he was allowed to choose freely within the application (Bimiboo) consisting almost entirely of puzzling or sorting and matching tasks (shapes, sizes, and colors). A timer was set for 10 minutes in order to gather sufficient observation material. There were 16 total measurements: 7 measurements with the manual tasks and 9 measurements with the iPad.

Procedure

The videotapes were scored after all the data was obtained. They were randomized by an independent individual and scoring criteria were discussed by the scorers before beginning. The data was scored by the coördinating researchers who had no role in the intervention. Measurements were done by the teachers, and the scorers were also blind for when which measurement was done. Preceding the scoring, the two scorers determined the criteria for the different types of distraction

(standing up from the chair, calling the teacher, or turning around on the chair), and it was determined when timing was stopped for “effective working time.” Scorers watched and scored one film together in order to reach consensus on criteria and manner of scoring (this film was excluded from the analysis because it was too short), and this information was added to the score form for reference during scoring. Also, 33% of the films were randomly selected and then also coded by an independent coder.

Instrument: Attention span

The score form for the dependent variable “attention span,” consisted of various observations (including standing up from the chair, calling the teacher, and turning around on his chair). A score was only recorded when the participant actually stopped working to change behavior. All films were scored twice, once to score behavior and once with a stopwatch to measure effective working time.

Six films were used for scoring while performing manual tasks, and nine films were used for scoring while working on the iPad. Recordings stopped after he finished his manual tasks which mostly took 9 or 10 minutes. We therefore decided to set the working time on the iPad on 10 minutes. Looking at all the available measurements, which were variable in duration, we decided to adjust the scoring time to 9 minutes per video since we wanted to have as much scoring time as possible. While three of the manual task recordings were shorter than 9 minutes (24, 34, and 46 seconds shorter), the decision was made to estimate the remaining results for the shorter recordings, resulting in corrected scores for these three films. These were calculated by looking at the number of distractions or the total effective working time within the time of the film, and correcting this to 9 minutes by counting proportionally. For example 10 distractions in 8 minutes is 1.25 distraction per minute and the total for 9 minutes would come to 11.25.

Data analysis

The two observers used mean scores to analyze the data. To compare the outcomes of the manual and iPad tasks, for both total distractions and effective working time. Standard deviations (SD) and range were used to analyze the consistency of the results. If the observers’ scores differed by more than 2 SDs, the videotape was reviewed and scored again by both observers at the same time to reach consensus, and the consensus score overruled the mean score, which happened once.

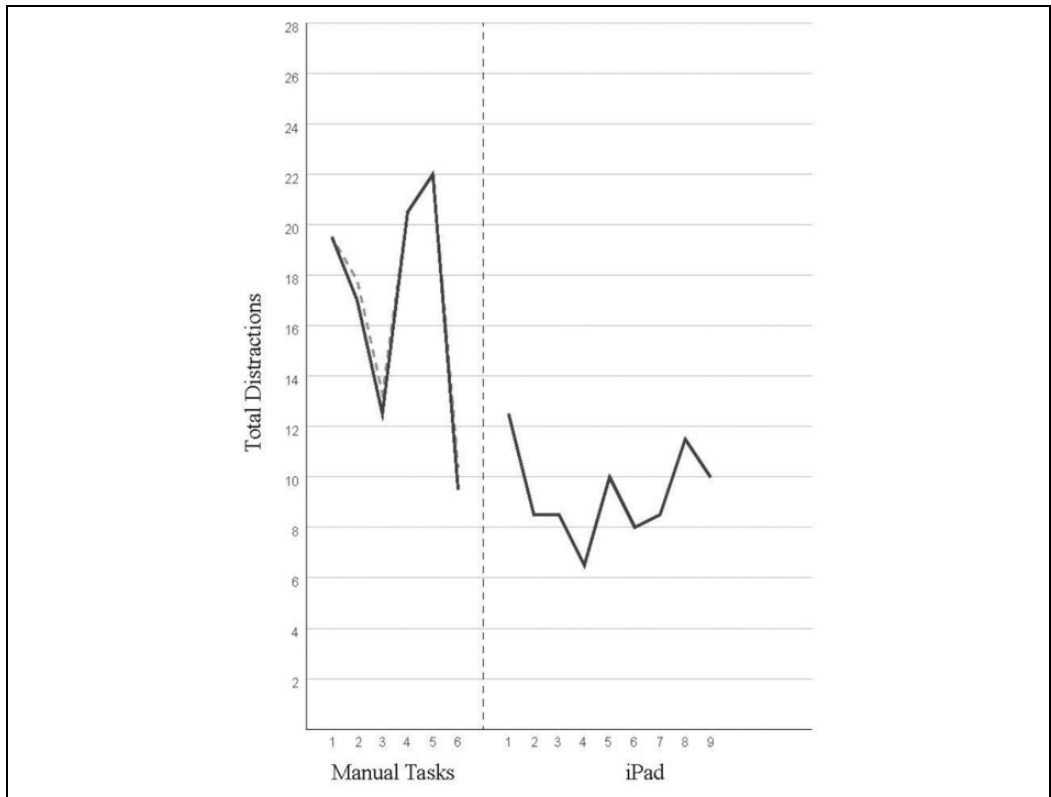
Results

Total distractions

The mean score for the amount of distractions was 16.8 for the manual tasks (SD 4.5) and 9.3 for the iPad tasks (SD 1.8) (Table 1), which represents a 45% decrease in distractions when performing tasks on the iPad. The results also showed a smaller range, suggesting that the participant worked more consistently on the iPad. Neither the manual nor the iPad tasks show a downward trend, so there does not appear to be an overall decrease in distractions and the A condition does not effect the B condition (Figure 1). Analyses of the corrected scores indicate a larger decrease in distractions following correction. The mean score for total distractions during manual tasks increased to 17.3 (SD 4.5) and the decrease rises to 46% using corrected scores, and the correction was therefore accepted.

Table 1. Outcome measures for the baseline (manual tasks) and intervention phase (iPad tasks).

	Manual tasks (n = 6)		iPad (n = 9)	
	Mean (SD)	Range	Mean (SD)	Range
Total distractions (frequency)	16.8 (4.5)	9.5-22	9.3 (1.8)	6.5-12.5
Effective working time (%)	79.4 (8.1)	67.6-87.3	87.0 (3.1)	81.9-93.6

**Figure 1.** Mean scores for total distractions while working tasks manually and on the iPad.

The results of the third independent coder matched the results of the first coder with an ICC of .967 for the scoring of Total distractions, as well as of the second coder with an ICC of .951.

Effective working time

The mean score for effective working time was 79.4% (SD 8.1) for the manual tasks and 87.0% (SD 3.1) for the iPad (Table 1). This means that working with an iPad improves the effective working time by nearly 8%. The results also show a more consistent range while working with the iPad compared to working on tasks manually (Figure 2).

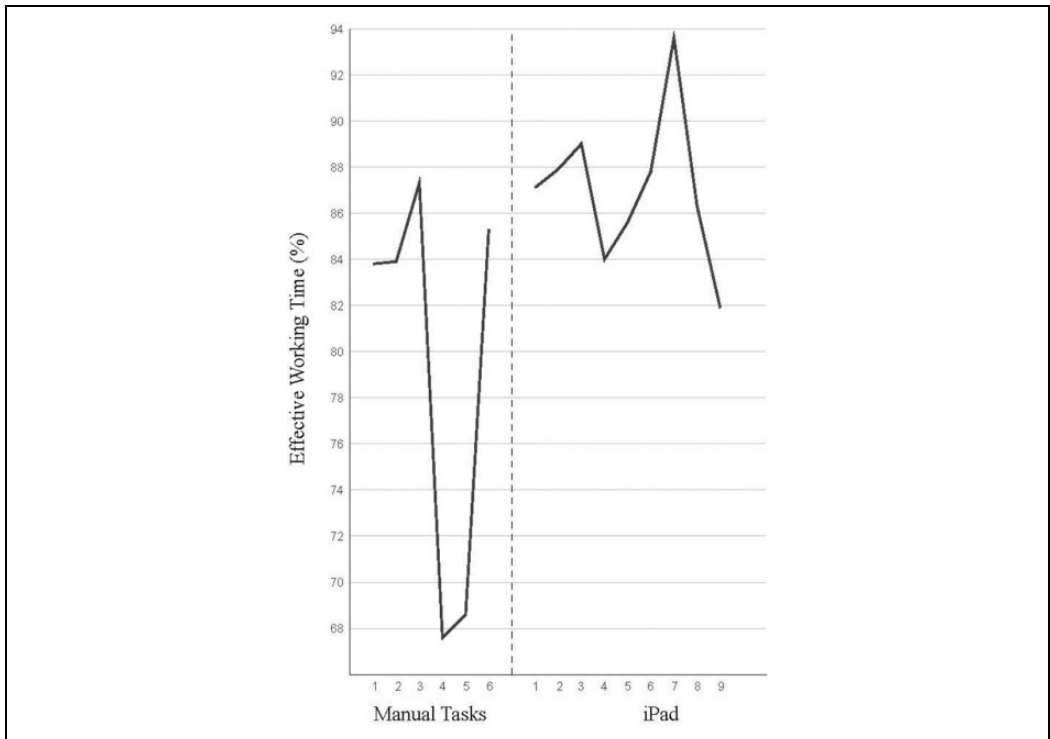


Figure 2. Mean scores for effective working time while working on tasks manually and on the iPad.

A decision was made to check whether the dip in the data seen for the manual tasks (videotape 4 and 5) could be explained by the participant having a particularly difficult or unusual day. However, we determined that the videotapes were made on different days and both teachers confirmed no peculiarities on the days in question.

The results of the third independent coder matched the results of the first coder with an ICC of .856 for the scoring of Effective working time, as well as of the second coder with an ICC of .904.

Task enjoyment

Although this was not directly measured, the results were notable and require mention. While reviewing the videotapes, the observers noticed much more enjoyment when the participant was working on the iPad. He enjoyed the positive feedback animations the apps gave him, and he demonstrated this by laughing, saying “yes,” and by proudly telling the teachers, followed by a return to independent work. While working on his manual tasks he was sometimes pleased when he completed a task, but to a lesser degree and not during the task.

Teacher report

One of the teachers participated in a semi-structured interview. She is a daycare center worker who has known the participant for 3 years.

She noted that the participant was much more distracted while performing tasks manually. She speculated that poor fine motor skills contribute to this, in addition to the participant's position in the group while performing the task. She suggested that working in a TEACCH setting may not be the best option for him, because while it is a confined space designed to prevent distraction, he seemed to actively search for distractions. Manual tasks also require additional successive actions, such as tidying and replacing the finished task and retrieving a new task, and the participant is easily distracted during these actions.

The teacher reported that the iPad was much more stimulating for him and that he ran to his chair when he heard that he could work on the iPad, a notable difference compared to the manual tasks. He was enthusiastic while working on the iPad and sometimes called the teacher's name, typically to show her his results. One of her most important observations was that he resumed working following distraction without verbal instruction from the teacher much more frequently than when working on tasks manually.

Discussion

This study investigated the effectiveness of iPad use on the attention span of a child with Smith Magenis Syndrome. We hypothesized that his attention span would improve while working on tasks with an iPad rather than performing them manually, and we expected that a child with SMS would show fewer distractions and improved effective working time when using an iPad. The results indicate that iPad use drastically decreases the amount of distractions and slightly improves the effective working time of our participant. He also showed more enjoyment when working on the iPad and preferred it over working on tasks manually. He required less guidance from the teacher when using the iPad and began his task without verbal instruction from his teacher.

Our results are in agreement with previous studies also showing a positive effect of tablet use for children with disabilities. For example, we noticed that our participant was capable of improving his iPad skills. This is also reported by Chmiliar (2017). In that study she investigated improvements in early learning skills in preschool children with disabilities in an inclusive school program, using an iPad with early learning apps over a period of 21 weeks. One of the conclusions was that all participants ($n = 8$) learned how to use the iPad independently. Den Brok and Sterkenburg (2015) performed a literature review of 28 articles and found that there is scientific evidence that technology supports the learning of activities of daily living as well as cognitive concepts (such as time perception and imagination) in children and adults with ASD and/or mild to moderate intellectual disabilities. The results of the included studies showed that task performance increased during the intervention phase and that it can be maintained but may decline during the follow-up.

Our findings that our participant showed a lot of excitement when working at the iPad harmonises with Allen et al.'s (2016) research in which they state that children's motivation to engage with learning material should not be overlooked, because motivation processes directly impacts knowledge acquisition and transfer. We agree that the attractiveness of tablets and other new technologies may be useful in supporting better learning outcomes. However, social interaction remains an important factor when mentoring a child and must not be forgotten while working with new technologies (Lovato and Waxman, 2016).

This single case study also raised the question of whether there might be a more permanent solution for improving attention span for children with SMS. Children with ADHD sometimes benefit from medication (Sharma and Couture, 2014), which may also be a solution for children

with SMS. But so far there are no recommendations on the prescription of psychotropic drugs (Poisson et al., 2015).

Smith et al. (2001) advise that individualized instruction, structure, and routine might help minimize behavioral problems in the school setting. Therefore, a structured school program with one-on-one support and curricula matched to the known cognitive and behavioral profile of children with SMS could be effective in addressing the needs of these students. The current single case study suggests that the use of an iPad may also contribute in the care for children with SMS. And although the iPad could be a good addition for children with poorer, finer motor skills such as SMS, our suggestion is not that the iPad should be used instead of working manually. It still remains important to stimulate fine motor skills, for example because of their role during ADL activities (tying shoe laces, doing up buttons).

Limitations

Although this study provides important insights in relation to this individual participant, there are some reservations that need to be made. Firstly, we only report short-term results for a single subject, obtained while working at a table. Implementing tablet use over an entire school day and investigating long-term results was not part of the study, but should be examined in the future. Besides that, it is valuable to perform this study with more participants. Secondly, the magnitude of the increase in effective working time may be artificially reduced by the scoring method. Manual task time was also scored when the participant was finishing a task, clearing it away, or clearing up the mess after the task had fallen on the floor, as well as while starting a new task including sticking the pictograms on the task strip or pulling the chair up to the table. We decided that this was all part of the task, but it was not necessarily all effective working time. It is possible that the results would be different if only the hands-on time was scored, the effective working time would be less while working on the tasks manually, and the results would have been even more in favor of the iPad. Third, there were never more than two other children in the group while the participant was working, and in a classroom setting there are likely to be more children present, which could cause more attention problems. We believe that children with SMS or attention problems could benefit from temporarily dividing into smaller groups while working.

We are also aware of the fact that the tablet was very rewarding, especially compared to the manual tasks. None of the manual tasks had sound effects like the tablet. For his reward, the participant was dependent on his teacher, although it is difficult to say if he didn't feel any satisfaction or joy while finishing a manual task. The joy of playing with something new and rewarding though might have played a role in the positive results. On the other hand this can work to the advantage of the teacher. Due to new rewarding technologies, the teachers can create more customized care in the classroom. At last, data should preferably be scored by independent scorers. However, due to practical and financial reasons the main scoring was done by the coordinating researchers, and checked for impartiality by having an independent scorer re-score 33%.

Our results should be interpreted carefully. While we report good results when the participant was working at a table, it will not always be possible to use a tablet. There will also be times in the day when skills such as eating and drinking, free play, sporting, craftwork, or others will be needed, and these skills cannot be replaced by a tablet. There is again a risk of distraction and attention seeking behavior during this time, and further research is needed to examine the application of elements of the iPad to other activities.

Future research and general conclusion

Obtaining additional information about this syndrome could improve understanding of the associated behaviors and make it possible to adapt certain behaviors such as the fascination for adult attention into daily programs in a positive way. Treatment for Smith Magenis Syndrome is complex, requires a multidisciplinary approach with several specialists and paramedics, and will always remain a challenge. This single case study shows how the use of technology can influence attention in a positive way and therefore perhaps improve classroom performance of an individual with SMS. It also shows that the development of strategies to engage individuals with neurodevelopmental disabilities in the educational setting is important endeavor that is to be commended.

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References

- Abdelkarim O, Ammar A, Chtourou H, et al. (2017) Relationship between motor and cognitive learning abilities among primary school-aged children. *Alexandria Journal of Medicine* 53: 325–331.
- Allen ML, Hartley C and Cain K (2016) iPads and the use of “apps” by children with autism spectrum disorder: do they promote learning? *Frontiers in Psychology* 7: 1305.
- American Psychiatric Association (2013) *The Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: author.
- Arthanat S, Curtin C and Kontak D (2013) Comparative observations of learning engagement by students with developmental disabilities using the iPad and computer: a pilot study. *Assistive Technology* 25: 204–213.
- Ayres AJ (1972) *Sensory Integration and Learning Disabilities. A Systematic Review of Sensory Processing Interventions for Children with Autism Spectrum Disorders*. Los Angeles, CA: Western Psychological Services.
- Case-Smith J, Weaver LL and Fristad MA (2015) A systematic review of sensory processing interventions for children with autism spectrum disorders. *Autism* 19: 133–148.
- Chmiliar L (2017) Improving learning outcomes: the iPad and preschool children with disabilities. *Frontiers in Psychology* 8: 660.
- Coutinho F, Bosisio M, Brown E, et al. (2016) Effectiveness of iPad apps on visual-motor skills among children with special needs between 4y0m–7y11m. *Disability and Rehabilitation: Assistive Technology* 12(4): 402–410.
- De Leersnyder H, de Blois MC, Claustrat B, et al. (2001) Inversion of the circadian rhythm of melatonin in the Smith-Magenis syndrome. *The Journal of Pediatrics* 139: 111–116.

- Den Brok WLJE and Sterkenburg P (2015) Self-controlled technologies to support skill attainment in persons with an autism spectrum disorder and/or an intellectual disability: a systematic literature review. *Disability and Rehabilitation: Assistive Technology* 10(1): 1–10.
- Dykens EM, Finucane B and Gayley C (1997) Cognitive and behavioural profiles in persons with Smith-Magenis syndrome. *Journal of Autism and Developmental Disorders* 27: 203–211.
- Elsea SH and Finucane B (2009) *Smith-Magenis Syndrome*. *Encyclopedia of Life Sciences*. London: IntechOpen.
- Faber JM and Visscher AJ (2016) *De effecten van Snappet. Effecten van een adaptief onderwijsplatform op leerresultaten en motivatie van leerlingen*. Enschede: Universiteit Twente. Available at: https://www.kennisnet.nl/app/uploads/kennisnet/leren_ict/leren_op_maat/bijlagen/De_effecten_van_Snappet_Universiteit_Twente.pdf (accessed 13 November 2018).
- Greenberg F, Guzetta V, Montes de Oca-Luna R, et al. (1991) Molecular analysis of the Smith-Magenis syndrome: a possible contiguous-gene syndrome associated with del(17)(p11.2). *American Journal of Human Genetics* 49: 1207–1218.
- Kagohara DM, van der Meer L, Ramdoss S, et al. (2013) Using iPods and iPads in teaching programs for individuals with developmental disabilities: a systematic review. *Research in Developmental Disabilities* 34: 147–156.
- Kratochwill TR, Hitchcock J, Horner RH, et al. (2010) Single case designs technical documentation. *What Works Clearinghouse: Procedures and Standards Handbook*. What Works Clearinghouse. Available at: <http://files.eric.ed.gov/fulltext/ED510743.pdf> (accessed 9 January 2020).
- Kratochwill TR and Levin JR (2014) *Single-Case Intervention Research: Methodological and Statistical Advances*. Washington, DC: American Psychological Association.
- Laje G, Bernert R, Morse R, et al. (2010) Pharmacological treatment of disruptive behavior in Smith-Magenis syndrome. *American Journal of Medical Genetics* 154C(4): 463–468.
- Lovato SB and Waxman SR (2016) Young children learning from touch screens: taking a wider view. *Frontiers in Psychology* 7: 1078.
- Martin SC, Wolters PL and Smith ACM (2006) Adaptive and maladaptive behavior in children with Smith-Magenis syndrome. *Journal of Autism and Developmental Disorders* 36: 541–552.
- Meijer S, Woittiez IB and Ras M (2010) Verstandelijke handicap: welke zorg gebruiken patiënten en wat zijn de kosten? In: *Volksgezondheid Toekomst Verkenning*. Bilthoven: RIVM. Available at: <http://www.nationaalkompas.nl/gezondheid-en-ziekte/ziekten-en-aandoeningen/psychische-stoornissen/verstandelijke-handicap/welke-zorg-gebruiken-patienten-en-kosten/> (accessed 13 November 2018).
- Mesibov GB, Shea V and Schopler E (2005) *The TEACCH Approach to Autism Spectrum Disorders*. New York, NY: Springer.
- O'Malley P, Lewis MEB and Donehower C (2013) Using tablet computers as instructional tools to increase task completion by students with autism. Online submission. Paper presented at the *Annual Meeting of the American Educational Research Association*.
- Påhlman M, Gillberg C, Wentz E, et al. (2020) Autism spectrum disorder and attention-deficit/hyperactivity disorder in children with cerebral palsy: results from screening in a population-based group. *European Child & Adolescent Psychiatry* 29(11): 1569–1579.
- Pieters M and Treloar R (1995) *Kleine Stapjes: een Early Intervention methode voor kinderen met een ontwikkelingsachterstand*. Bussum: V&V Producties.
- Poisson A, Nicolas A, Cochat P, et al. (2015) Behavioral disturbance and treatment strategies in Smith-Magenis syndrome. *Journal of Rare Diseases* 10: 111.
- Rabiner D and Coie JD (2000) Early attention problems and children's reading achievement: a longitudinal investigation. *Journal of the American Academy of Child & Adolescent Psychiatry* 39(7): 859–867.
- Rutgers E, Hilderink A, Venhuizen M, et al. (2019) Onderzoek maatregel 8 onderwijs zorgbrief: op weg naar een optimale ontwikkeling voor ieder kind. Ministerie van Volksgezondheid, Welzijn en Sport. Available at: <https://www.rijksoverheid.nl/ministeries/ministerie-van-volksgezondheid-welzijn-en-sport/documenten/>

- rapporten/2019/10/30/onderzoek-maatregel-onderwijszorgbrief-op-weg-naar-een-optimale-ontwikkeling-voor-ieder-kind (accessed 9 January 2020).
- Schmerse D (2020) Preschool quality effects on learning behavior and later achievement in Germany: moderation by socioeconomic status. *Child Development* 91: 2237–2254.
- Sharma A and Couture J (2014) A review of the pathophysiology, etiology, and treatment of attention-deficit hyperactivity disorder (ADHD). *Annals of Pharmacotherapy* 48(2): 209–225.
- Slager RE, Lynn T, Newton TL, et al. (2003) Mutations in RAI1 associated with Smith-Magenis syndrome. *Nature Genetics* 33: 466–468.
- Sloneem J, Oliver C, Udwin O, et al. (2011) Prevalence, phenomenology, aetiology and predictors of challenging behaviour in Smith-Magenis syndrome. *Journal of Intellectual Disability Research* 55(2): 138–151.
- Smith ACM, Boyd KE, Elsea SH, et al. (2001) Smith-Magenis syndrome. Seattle, WA: University of Washington, pp. 1993–2018. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK1310/> (accessed 9 November 2020).
- Smith ACM, Dykens E and Greenberg F (1998) Behavioral phenotype of Smith-Magenis syndrome (del 17p11.2). *American Journal of Medical Genetics* 81: 179–185.
- Tellegen P (1998) *Snijders-Oomen Niet-verbale Intelligentietest*, Swets & Zeitlinger BV Lisse. Netherlands, ISBN 9026515324.
- Udwin O, Webber C and Horn I (2001) Abilities and attainment in Smith-Magenis syndrome. *Developmental Medicine & Child Neurology* 43: 823–828.
- Van der Felsa IMJ, te Wierike SCM, Hartman E, et al. (2015) The relationship between motor skills and cognitive skills in 4–16 year old typically developing children: a systematic review. *Journal of Science and Medicine in Sport* 18(6): 697–703.
- Vasudevan P and Suri M (2017) A clinical approach to developmental delay and intellectual disability. *Clinical Medicine* 17(6): 558–561.
- Warner-Rogers J, Taylor A, Taylor E, et al. (2000) Inattentive behavior in childhood: epidemiology and implications for development. *Journal of Learning Disabilities* 33(6): 520–536.
- Wilde L, Silva D and Oliver C (2013) The nature of social preference and interactions in Smith-Magenis syndrome. *Research in Developmental Disabilities* 34: 4355–4365.
- Wiley B, Cameron D, Gulati S, et al. (2014) Exploring the use of tablets (iPads) with children and young adults with disabilities in Trinidad. *Disability and Rehabilitation: Assistive Technology* 11(1): 32–37.
- World Medical Association (2013) Ethical principles for medical research involving human subjects of the world medical association declaration of helsinki. *JAMA* 310(20): 2191–4.