

School-Aged Children Paper-Book Read Concentration and Digital Technology Use

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ABSTRACT

Reading attention has caught the interest of academics and society for years. With more children exposed to digital technology devices since a young age, a previous study pointed out that some digital stimulation would decrease the children reading concentration. However, whether the digital technology device use would influence attention was not mentioned. This study aims to explore the association between digital technology use and paper-book reading attention. A two-week experiment was designed and two groups of participants aged from 10 to 12 years old attended. Using counterbalancing across groups, one week was the control week, during which participants were prohibited from using any digital technology device, and the paper-book reading concentration relating data was collected, and the other was the natural observation week collecting the same behavioral data but without manipulation. The results supported the idea that less time spent on the digital technology device would help children concentrate for a longer attention span on paper-book reading. This finding noted a possible implication on education and children's reading attention improvement.

Keywords: Attention, Paper-book reading concentration, Digital technology device, Adolescence.

1. INTRODUCTION

Scientists and society have widely studied children reading behavior and agreed that reading behavior is crucial for children's development, building many strategies for improving reading ability [1,2]. Reading has also been believed associated with some other functions or learning skills relating to children development, such as word learning [3], verbal and visuospatial working memory [4], oral language skills [5], and may even determine the structure of children development changes [6].

A previous study conducted by Savage and colleagues stated a close relationship between attention deficit and reading ability [7]. The above study mentioned that attention was associated with cognitive functions such as inhibition control, allowing people to control their impulses and keeping on the appropriate behavior towards the goal [8] while inhibitory control was also firmly related to reading. Rabiner and his colleagues also noticed that under control of IQ and prior reading achievement, children reading behavior could still be predicted by attention [9]. Attention seemed to have a close association with reading behavior, in the meantime, is also a crucial function on children's

development. However, attention capacity was limited with the processing speed and apprehension span [10]. If taken up by other events, then there would be less capacity left for energy-consuming behavior such as reading.

Diverse forms of reading appeared in recent years, such as electric readings, and virtual reality book reading [11]. For children, the most common and related forms of reading would be paper-book reading. While arousal level was usually associated with the excitement of brain activation, paper-book reading was a low arousal stimulus. For the low arousal stimuli, if people or children wanted to concentrate on it, continuous attention and low environmental and cognitive stimulation were required [12]. Therefore, if improving reading achievement, especially for paper-book, not only should children inhibit other behavior since the attention capacity was limited, but also stay in a low stimulation and effortful concentration.

Yet, according to the data collected by Konca, children nowadays lived in a rich digital technology environment, especially at home [13]. In recent years, the age children began to expose to digital technology devices has decreased and the proportion of children

owning mobile devices or tablets has increased [14, 15]. The researcher conducted a questionnaire before the beginning of the experiment to the assigned classes in the primary school. One question collected what function do the children use with the access to the digital technology devices. Among the 79 results gathered, the options of mandatory homework from school took up the maximum portion 48% and followed by short-form video viewing, with 29% of answers. Compared to paper-book reading, short-form video and digital technology devices were higher arousal stimuli that would bring more excitement to the brain, with colorful and diverse visual and auditory stimuli.

A previous study learned the association between reading behavior and digital device [11]. Wang and colleagues were interested in four forms of storybooks across different multisensory stimulation and level of interactivity, which were the paper book, app book or e-book presented on the mobile device, flash animation integrating visual and auditory stimulation, and augmented reality (AR) book, which immersed people in a story by physically engaging multisensory input. Children participants' reading concentration increased on flash animation but decrease on both app books and AR books while reading interest was increased for flash animation and AR books. They also concluded that low interactivity, which included paper books and flash animation on their paper, maybe a critical key to reading concentration. Still, the researchers did not mention how to improve the paper book reading attention or concentration.

Knowing how low interactive stimulation may extend the attention span on reading, the researcher wanted to know when controlling the time spent on the digital technology device, whether the children would be able to concentrate on paper-book reading and pay enough attention to reading. Although paper-book reading required a more restricted environment to focus on, controlling the high arousal entertainment could release some attention capacity and leave a low and quiet environment and cognitive stimulation.

To measure attention on reading, attention dwells time, which was a direct and simple measurement of visual attention used by scientists for years [16, 17]. In this study, the researcher also recorded attention dwell time as a measurement on paper-book reading through observers.

This paper clarifies the impactors on paper-book reading attention of children aged 10-12 years old may be impacted by digital technology device use. The hypothesis was that if being prevented from using the spare time spent on-screen or digital technology devices, students aged 10-12 years old would spend more time on paper-book reading.

2. METHODS

2.1. Participants

Twenty-six student participants (13 males; 13 females) attended the study and were all adolescence aging around 11 years old ($M = 10.80$, $SD = 0.73$). Before participating in the study, informed consent was provided to the students and their parents and collected back with signatures and agreement from both of them. Seventy-nine families signed the informed consent and completed the first quarantine of the study, but only 23 of them completed all the questionnaires. All the participants were students from Grade 5 and Grade 6, a primary School, in Shenzhen China. There was no reading obstacle or attention deficit reported by these families and the participants. According to their classes, participants were divided into two groups. To protect the privacy of the student-participants, no real name would be used in the questionnaires and data analysis. Student number was used to replace their names. Participants were assigned into two groups based on classes. They were assigned into two counterbalancing groups to avoid order effect.

2.2. Materials

There are three questionnaires included in this study. All the questionnaires were designed by Wenjuanxing, a questionnaire design website in China, and launched through Wechat, only containing about 8 questions and can be completed within 2 min. The families who agreed to attend the experiment were invited to a specific group chat in Wechat, and the questionnaires were delivered and submitted in the group chat weekly.

In the first section of the study, Questionnaire One (Q1) was delivered to all 81 families. The questions included demographic information (e.g., student number, gender, and age), paper-book-reading habits, and electric-devices-using habits. Questions here demonstrated students' daily habits.

In the second section of the studies, there existed two questionnaires. Q2-1 was delivered on the control week of study and Q2-2 was for the natural week. These two questionnaires were completely the same and both collected demographic information, students' paper-book-reading time, and digital technology device using time during that week.

The choices for time spent on paper-book reading or digital technology devices use were 30 min, 40 min, 50 min, and 60 min. The instruction suggested choosing 30 min for 30 min or less and 60 min for 60 min or more.

2.3. Procedures

For the first section of the study, demographic information about students and their paper-book-reading and digital technology device habits were gathered by Q1.

For the second section of the study, the families were assigned into two groups by class. Two groups would both experience a natural week and a control week. By counterbalancing, Group one experienced the control week first and then the natural week, and Group two experienced the natural week first and then the control week.

On the day before the natural or control week, parents were instructed in the assigned group chat about the study requirement. All they needed to do for the natural week was natural observation. Rather than additional instruction to children, parents would observe and record the paper-book-reading behavior, such as duration and types of the book the students read, and the digital technology device habit, such as duration and function. For the control week, parents were required to strictly control students' digital technology device use on the weekdays and try their best to advise the students to do paper-book reading.

Q2-1 and Q2-2 would be delivered by the end of Friday and collected the next Monday. All the questionnaires were completed by the parents and it was the parents who observed and collected the data.

2.4. Data analysis

The questionnaires were collected by Wenjuanxing, and the data was analyzed by Jamovi. The independent variable was digital technology device use. The dependent variable was the time spent on paper-book reading. Before the data analyses on natural week and control week, a hypothesis test was used to examine the homogeneity of Group one and Group two through Jamovi. Two paired sample t-tests were then used to analyze students' paper-book reading time for both groups.

3. RESULTS

Comparison of paper-book reading time before study reported by parents retains that two groups are homogeneous on reading habit. There was no significant difference in time spent on paper-booking reading per day before study between students from two groups, $t = 0.97 < t(1-0.05, 24) = 1.71, p > 0.05, d = 0.381$. The average time Group One students spent for paper-book reading before the study was 44.6 min (SD = 9.67), and for Group Two was 40.0 min (SD = 14.1). Students' daily time spent on the digital technology device used before the study was collected by their parents before the study. Data were compared between two groups to examine whether there existed an individual difference between groups before manipulation. No significant difference was noticed in digital technology device using habit, $t = 0.45 < t(1-0.05, 24) = 1.71, p > 0.05, d = 0.176$. The average time Group One students spent for the digital

technology device use before the study was 30.8 min (SD = 16.56), and for Group Two was 27.7 min (SD = 18.3).

For Group One, students experienced the control week first and then the natural week. The data fails to reject the null hypothesis, $t = 1.24 < t(1-0.05, 12) = 1.78, p > 0.05$. As depicted in Figure 1, a small-time difference was noticed compared to the time spent on paper-booking reading during the control week (M = 46.9, SD = 11.1) and during the natural week (M = 43.1, SD = 11.8). For Group Two, students would first go through the natural week and then the control week, when they were not allowed to use a digital technology device. Data collected from Group Two showed the analyses on recorded paper-book reading time during two experiment weeks. There is a significant difference, $t = 2.41 > t(1-0.05, 12), p < 0.05$. Figure 1 shows that, during the weekdays, the average time students spent on paper-book reading during the natural week (M = 36.2, SD = 18.0) was shorter than during the control week (M = 45.4, SD = 12.0), as hypothesized.

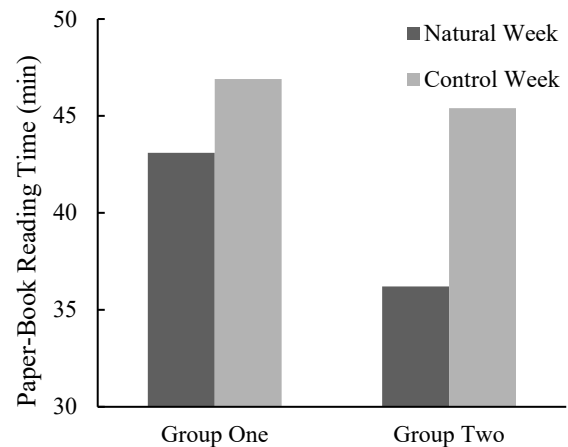


Figure 1 Comparison of paper-book reading time between two groups in nature week and control week.

4. DISCUSSION

This study aimed to figure out whether the time spent on the digital technological device will impact the paper-books reading attention, and reduce the time spent on paper-book reading. The hypothesis is that if being prevented from using the digital technology device, 10 to 12 years old students may spend more time on paper-book on weekdays. The data partially supported the hypothesis. For Group one, which experience the control week first, the control of using digital technological devices did not contribute much to the changed amount of time students spent on paper-book reading. However, for Group two, which experienced the natural week first and then the control week, there was a significant increase in time spent on paper-book reading during weekdays after the manipulation of the digital technological device using.

For the different effects reflected from data between the two counterbalanced groups, the researcher hypothesized that it may be because the manipulation lasted even after the control week. On the second week for Group One, which was assigned as the natural observation week, there showed an insignificant difference compared to the control week. The manipulation of using digital technology devices may still have an impact on students' reading behavior when the experiment went on. In this case, although without any additional control, how the students behaved was not truly reflecting the natural situation. What was recorded was still under the effect of manipulation. Participants' reactivity may be another reason for the small reading time difference between two weeks for Group One. If the first week was the control week, students may be aware of being part of the experiment and behave better than normal to fulfill social preference or researcher expectancy. Students assigned the informed consent knew that the study may last for more than one week. Therefore, on the following week, even though it was announced as the natural week and the researcher expected to collect the natural data as students would behave in real-life situations outside of the experiment, students may unconsciously spend more time on reading paper-book than normal.

On the natural week, parents did not intervene in children's behavior after school, while on the controlled week, parents tried to force the children to read more paper books and strictly limit the digital technological device. It may be parents' attitudes that affected children's performance. When parents strongly advise the children to read more after school, they would read for a longer time. Meanwhile, from the feedback of one child, she indicated that without using a digital technology device after school, she was more easily to calm down and focus to read.

There are some possible explanations for this phenomenon. Firstly, some families have their own family rule about digital technological device use and own schedule for afterschool time. From the group chat, one parent stated that in her family, the child does not own his mobile phone and could not use a digital technology device on weekdays. Also, these children themselves favor paper-books reading so much and would love to spend their spare time reading. This may explain the phenomenon that time spent on the digital technological device did not change much between two weeks. Meanwhile, the teachers mentioned that daily reading homework was assigned for students after school.

Secondly, participants voluntarily attended the study. Those who attended the study may be more interested in paper-book reading than others or were willing to form a good paper-book reading habit. In this case, their time spent on paper-book reading may be longer than average students even before the study was held. Thirdly, the

children aged 10 to 12 or adolescence are lack self-discipline [18]. They are more used to listening to their parents on modifying their behavior. No matter during the experiment or on their daily, they keep their everyday habits as their parents instruct.

This study is not free of limitations. The samples of this study were all children aged 10 to 12 years old from four classes in one primary school, Shenzhen China. There are only 26 participants included in this study, more participants should be included. Since these were classmates and the purpose of the study was told ahead, they may communicate before the data was collected, which leads to the risk of unconscious fulfilling observer preference behavior. Participants were assigned into two groups according to their classes. It is hard to decide whether the four classes selected receive a generally equal academic performance and generally the same studying habit. The observers in this study were the parents of the participants. These parents were not trained to record the behavior and may misrecord the information. Some related behavior may even be ignored during the study. The study was only held for two weeks. However, on average, the duration for a habit to form is about 66 days [19]. If the experiment duration is longer, the paper-book reading may be formed. In this case, the independent variable, digital technological device use, can be truly controlled. To simplify the questionnaire, the choices of time set on the questionnaire were 30 min, 40 min, 50 min, and 60 min. These choices were designed based on the data collected from Q1, which gathered the reading habit before the study. Yet, the time recorded is not precise enough. Students may spend more than 60 min or less than 30 min, but could not be present by the result of choices. There was also a blank left for parents to fulfill if they have a precise and accurate time, but no data was collected from this choice.

For further study, more participants can be invited. Other age ranges can also be included. Also, considering that parents ruling on children reading behavior may be one of the critical effectors on changing children's reading performance, future studies can consider collecting data from both the parents and children. While children are the ones who modify and impact the behavior, parents here are only an observer and should not intervene in the experiment.

The implication of the result can be family education. According to the result of the study, parents; education on children may contribute to a huge change or improvement in children's daily habits. Parents may accompany their children more and lead them better studying habits by always suggesting the children behave right.

Rather than family education, the result is also useful to school education. Whenever the teachers are assisting the students to form a daily habit, they may consider announcing the parents for help. While teachers can

modify most of the student's behavior at school, it is the parent who can modify children's behavior more effectively at home.

The result could also give the bookstore inspiration on the education-related books. A kind of book that allows both the parents and children to read simultaneously might bring a better reading habit to this family. The parents could behave as a model for the children to imitate to modify their reading habits [20].

5. CONCLUSION

This study provided evidence that reducing time spent on digital technology devices may be associated with higher attention or concentration on paper-book reading. If the children were prohibited from using the digital technological devices during weekdays and try to read more paper books in their spare time, their self-control and reading attention may assist them in insisting on the right and appropriate track, such as learning from books rather than wasting too much time on the screen entertainment. Teachers, families, and young children themselves can consider improving children reading attention and performance by reducing using digital technological devices. Meanwhile, this study demonstrated the critical impact of parents' instruction and accompany that happens on school-aged children behavior modification. Further studies are looking forward to other impacts that may improve children reading performance.

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