The Influence of WhatsApp Use on Teenagers' Working Memory: An Exploratory Study

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Abstract

Pupils use working memory in a wide variety of tasks, for remembering names, numbers, complex sentences, and working instructions. Impairing these functions may cause considerable learning difficulties. Technological advancement has brought about an increasing media usage, contributing to a way of life that is based on multi-tasking and continuous partial attention. Young people today believe that they have the capacity for simultaneous multi-tasking.

The present study examined the performance of the working memory system in pupils aged 12-17 in a setting of multi-tasking under distractions in the form of incoming text messages. The study confirms and augments the claims of previous studies regarding the negative effect of distractions caused by mobile media, and particularly by smartphones, on the cognitive performance of school children and university students both in class and in preparing school assignments at home. The present study expands and deepens the existing knowledge in this field and provides an understanding of pupils' habits of using smartphones and their ways of coping with distractions in the learning process. The findings of this study should help pupils, parents, and education professionals, contributing to heightened awareness and the development of new educational models which would drive the educational system towards an inevitable technological future.

Keywords: Smartphones distraction, Text messages, WhatsApp, Working memory, Multitasking.

Introduction

Interpersonal communication through cellular communications, and especially through smartphones, has become an integral part of our daily lives (Cellular News, 2013; Clabaugh, 2013). People use smartphones for voice calls, text messages, games, navigation, and social networking (Salehan & Negahban, 2013). One of the most common applications for text messaging is WhatsApp. WhatsApp contains several special features that add to its quick adaption. The enormous growth of technology use has created an expectation of continuous availability and response at all times and in all places. This may impair a person's ability to perform various daily tasks.

Problem statement

The current reality of availability at any time and place requires coping with more than one task at the same time. Recent changes in our lives, caused by technology, have contributed to a way of life based on multitasking and "sustained partial attention" (Friedman, 2006). Young people believe they have the ability to perform different tasks that require attention in parallel, such as text-messaging correspondence while studying, or talking on the phone while driving (Rogers & Monsell, 1995). However, these users do not control the place or the time they receive the messages. Finley et al. (2014) noted that people are not aware of the price they pay when their attention is divided.

To date, studies have not directly examined the effect of text messages using the WhatsApp platform during learning task fulfillment on the functioning of the working memory system. The present study will examine the direct effect of WhatsApp distractions on pupils' working memory.

Literature review

Smartphones

People use smartphones for various forms of communication, such as verbal, visual, and textual communication. These forms of communication play a central role in fulfilling their daily social needs. Ling (2008) claimed that cellular communication enables direct communication and experience more than any other media channel.

Text messages

The invention of SMS technology more than 20 years ago changed the way people communicate with each other. This technology has significantly modified interpersonal communication by implementing text-based communication over face-to-face or voice communications (Harrison & Gilmore, 2012).

Wei & Wang (2010) proposed that students who are used to sending text messages often are more likely to send them even during class time.

WhatsApp

Using WhatsApp creates an anticipation for attention and listening. The recipient of the message is expected to read it within minutes. WhatsApp suggests indicators for user availability. However, this creates a problematic expectation for both sender and receiver. In view of the situations described above, we have chosen to investigate the effect of using WhatsApp on working memory function.

Working memory

Working memory is the system that influences the capacity to store and manipulate information for short periods of time (Alloway, Gathercole, Kirkwood & Elliott, 2009). Various models of working memory distinguish between short-term memory and working memory (Baddeley, 2000; Baddeley & Hitch, 1974; Baddeley & Logie, 1999). Short-term memory is stores information temporarily, while working memory is liable not only for storage, but also for processing information. Working memory is the system that influences the capacity to store and manipulate information for short periods of time (Alloway, Gathercole, Kirkwood & Elliott, 2009). Students often need to rely on working memory in class in order to perform a variety of tasks. Working memory problems may lead to a failure not only in fulfilling complex assignments that combine storage, information processing and tracking task progress (Gathercole & Alloway, 2008; Gathercole, Lamont, & Alloway, 2006), but in performing simple tasks such as work instructions in class (Engle, Carullo, & Collins, 1991).

Multitasking

Multitasking can be defined as the ability to maneuver between two or more tasks simultaneously. It can also be defined as the ability to do more than one task in a sequence (Ajao, 2012). So far, research on WhatsApp has not yet investigated the harm caused by intensive use of MIM applications on pupils' working memory, which is an important component of cognitive information processing and executive functions. The current study seeks to shed light on the usage habits of the WhatsApp application among teenagers. It will explore the effect of MIM distractions on pupils' working memory performance. The results of this study may shed light on its effect on teenagers' cognitive functioning and work habits. This information may assist educational managers and policy makers in planning and implementing novel learning environments.

Hypotheses

H1: MIM distractions will decrease the results of working memory tests, and will present significant differences between the control group and study group.

H2: Participants who will experience WhatsApp distractions will report that the working memory tests are more difficult and less effective.

H3: A negative correlation will be found between the feeling of difficulty in sub-working memory tests and participants' achievements. A positive correlation will be found between participants' feeling of efficacy at sub-working memory tests and achievements.

Methodology

Data collection

Researchers conducted an experimental study based on a convenience sample. The research was conducted during the 2016 school year and encompassed 64 pupils. Of the participants, 24 (37.5%) were male and 40 (62.5%) were female.

Their ages were from 12-17. Participants were divided into an experimental group and a control group. There were 12 boys and 20 girls in each group. Criteria for choosing participants were:

Hebrew is their mother tongue.

They do not have cognitive or mental diagnoses, such as attention deficit hyperactivity disorders or mental disorders.

They do not have physical disabilities, such as hearing or vision impairments.

Measures

Research tools (Appendix1:

https://drive.google.com/file/d/0B69G80dGuAiCM19zMUcxRzViZVk/view?usp=sharing).

The Personal Information Questionnaire included seven questions about the health and functioning of their child, as well as demographic details.

The Execution Assessment Questionnaire of working memory subtest was comprised of three statements rated on a six-point Likert scale (1 = Not difficult at all, 6 = very difficult). In the first statement, respondents were asked to rank the difficulty level of working memory subtest. The second statement asked them to rank their efficiency in performing working memory subtest. Working Memory Index from the Wechsler Intelligence Scale for Children Wechsler 4 (Wechsler, 2003; examples are given in the Appendix). This version has a very high reliability ($\alpha = 0.7$ to 0.9). This study will use the sub-working memory test that includes three parts:

(1) Digit recall. Its Cronbach's Alpha is 0.84 and has two parts (remembering forward and backward).

(2) Series and letters. Its Cronbach's Alpha is 0.76 and contained two items set as an example, followed by 10 items, containing three sections each. In each section the tester read a series of letters and numbers (from two characters in the series up to eight characters in the series). The examinee had to repeat the numbers in an ascending order and then to repeat the letters in alphabetically order.

(3) Math Cronbach's Alpha is 0.92. The questionnaire contains 34 items of math word problems. Item 12 is the first item in this subtest (total 23 items) for ages 10-17. The tester reads a verbal

question, and the examinee has to give a numerical answer within 30 seconds. Examinees' answers were written in the appropriate column.

Procedure

The study sample was divided into two groups randomly—a control group and an experimental group. Each group contained 32 pupils. Each participant met with the researcher in a quiet room for 45 minutes. The study included a neuropsychological, rehabilitative psychologist from a well-known university in Israel.

Experimental group

Participants were asked to perform three subsets of working memory index in Wechsler-IV and, at the same time, distractions caused by WhatsApp were sent to them. Participants received scheduled messages after the tester read each question or section.

Each subject was given the following instruction: "In front of you, there are three subtests, which test memory while working. You are requested to concentrate in order to achieve the best possible result.

Control group

Three subtests were transferred in the same way that was carried out in experimental group (i.e., without distractions).

Results

Descriptive statistics

Table 1. presents participants' mobile use at school and at home

Statements	Frequency (as percentage)
Study with a tablet in school	
Study	16 (25%)
Not study	63 (73%)
A tendency to play or mess with Smartphones during class	
Tend to	28 (44%)
Not tend to	35 (54%)
Mobile mode while doing homework	
Regular	24 (37%)
Vibration	33 (51%)
Turned off	4 (6%)
Reading messages while doing homework	
Read	54 (84%)
Don't read	6 (10%)
Time of reading the message	
Immediately upon receipt	38 (59%)
After completing currently task	22 (35%)

Table 1 shows that the majority (73%) of students do not learn with a tablet at school and do not tend to use a mobile during class (54%). However, at home, about half (51%) of the pupils put the mobile on vibrate and the rest put it in normal mode (37%) or turn it off (6%). Most pupils read the messages they received while doing homework (84%), or on the spot (59%).

In order to examine whether there are differences between males and females, a series of t-tests were conducted. Table 2 presents the comparison between girls and boys on the research variables.

Table 2. shows that there are no significant differences between males and females

Measures	**Girls** ***N* = 40**	**Boys** ***N* = 24**	
	M(SD)	M(SD)	$t_{(62)}$
Digit recall test	12.21 (3.24)	12.03 (2.98)	0.23
Series letters test	9.88 (1.62)	9.90 (2.07)	0.05
Math test	11.17 (3.46)	9.68 (3.25)	1.73
Difficulty average	3.92 (0.85)	4.29 (0.78)	1.76
Efficiency average	3.36 (0.89)	3.61 (0.81)	1.14

*$p < 0.05$

Hypotheses

In order to examine the first hypothesis, which proposed that distractions from MIMs will decrease working memory subtests performance, researchers performed a one-way MANOVA. Significant differences were found concerning the three subtests (digit recall, series letters, and the math test) with F (3, 60) = 14.12, p < 0.001. The MANOVA revealed a significant difference, F (1, 62) = 8.09, p < 0.01 for the digit recall subtest. It seems that respondents who belonged to the experimental group had lower scores (M = 11.06, SD = 3.05) than those who belonged to the control group (M = 13.3, SD = 2.78). The MANOVA revealed another significant difference, F (1, 62) = 42.36, p <0.001 concerning the series letters memory subtest. Respondents who belonged to the experimental group had lower scores (M = 8.69, SD = 1.63) than those who belonged to the control group (M = 11.09, SD = 1.3). A third difference was found regarding the math test, F (1,62) = 10.27, p < 0.01. Again, respondents who belonged to the experimental group had lower scores (M = 8.97, SD = 2.94) than those who belonged to the control group (M = 11.5, SD = 3.36). Table 3 presents the differences between the groups.

Table 3. Results of the MANOVA analysis between the groups

Variable	Test group (with distraction)	Control group (without distraction)	$F_{(1,62)}$
	M (*SD*)	*M* (*SD*)	
Digit recall test	11.06 (3.05)	13.3 (2.78)	**8.09
Series letters test	8.69 (1.63)	11.09 (1.3)	***42.36
Math test	8.97 (2.94)	11.5 (3.36)	**10.27

$p < 0.01$, ***$p < 0.001$ **Respondents in memory tests

In order to examine the second hypothesis that assumed that participants in the experimental group will report that the working memory tests are more difficult and their work is less effective, researchers performed a T test. Significant differences were revealed in both measures. Respondents in the experimental group felt that the working memory tests were more difficult (t(62) = 2.09, p < 0.05; M = 4.27, SD = 0.88) than respondents who belonged to the control group (M = 3.84, SD = 0.75). They also reported that the tests were less effective (t (62) = 1.98, p <0.05; M = 3.36, SD = 0.83) than respondents who belonged to the control group (M = 3.76, SD = 0.88). Table 4 presents the differences between the groups.

Table 4. Participants' feelings of difficulty and efficiency

Measure	With distraction *N* = 32	Without distraction *N* = 32	$t_{(62)}$
	M (*SD*)	*M* (*SD*)	
The average level of difficulty	4.27 (0.88)	3.84 (0.75)	*2.09
The average level of efficiency	3.76 (0.88)	3.36 (0.83)	*1.98

*$p < 0.05$

In order to explore if there are correlations between the feelings of difficulty and of efficacy and working memory subtest achievements, researchers performed Pearson correlations. These are given in Table 5.

Table 5. Correlations between feelings of difficulty and efficiency and working memory subtest achievements (N = 64)

Measure	Digit recall	Series letters	Math working
Difficulty	***–0.52	– 0.13	**– 0.37
Efficiency	*0.29	– 0.04	***0.56

*$p < 0.05$ **$p < 0.01$ ***$p < 0.05$

Table 5 presents a significant negative correlation between the level of difficulty and respondents' digital recall working memory test, as well as a significant positive correlation between the level of efficiency and respondents' digital recall working memory test.

Discussion

The present study explored whether distractions such as WhatsApp text messages affect pupils' working memory. The rationale for the study stemmed from previous research that examined the effect of smartphones' on pupils and students' performance in the classroom and at home (Alzahabi & Becker, 2013; Minear et al., 2013; Ophir, Nass, & Wagner, 2009).

H(1) was accepted and participants who belonged to the experimental group had lower scores in the three subtests of working memory tests.

This finding echoes previous studies that explored the effects of using technology on pupils at home and in class. Peverly et al. (2012) suggested that because working memory is considered a limited resource, the distraction from mobile phones makes it difficult to encode material properly and take notes accurately during classes.

H(2) focused on participants' reports about their feelings of difficulty and efficiency. H(2) suggested that respondents who experience distraction from WhatsApp will report that the working memory tests are more difficult and less effective. This hypothesis was confirmed, and findings were in accord with those of Buchweitz, Keller, Meyler, and Just (2011) who examined individuals' ability to listen to two people who talk simultaneously, and with those of Watson and Strayer (2012) who explored people in a driving simulator while they were given memory tasks and problems to solve. Both studies indicated that multitasking performance is less efficient in terms of time and accuracy.

H(3) assumed that there would be a negative correlation between the feeling of difficulty in sub-working memory tests and participants' achievements, and a positive correlation between participants' feeling of efficacy at sub-working memory tests and achievements. When participants felt that the test was difficult, it lowered their digit recall and math scores; when they felt that they were efficient, their scores in digit recall and math were higher.

A similar finding was found by Kirschner and Karpinski (2010), who reported that multitasking involving receiving and processing information decreased both the efficiency of study habits and scores.

The main findings of the current study show that WhatsApp's distractions, transmitted via smartphones, decrease pupils' performance of working memory. In addition, students are aware of the difficulty WhatsApp causes while performing a learning task, and of the decrease in learning effectiveness.

The current study has theoretical as well as practical implications. On the theoretical level, it displays a unique experiment that explored the direct effect of the distractions stemming from a new technological platform: WhatsApp on young pupils' working memory. In addition, the study focused on young pupils, thus expanding the scope of research that considers young pupils' multitasking during the learning process.

On a practical level, the results of the current study suggest that instructors and teachers should be aware of the potential damage of multitasking caused by smartphone use during learning tasks. This can be done by providing students tools that will improve their learning strategies, instructors should create new learning programs that concentrate on content and integrate executive functions that will help students cope with distractions caused by technology. It is also recommended that smartphone use be limited during the school day, as a permissive policy that does not set clear boundaries negatively affects learning efficiency and quality.

Limitations and recommendations

The current study has several limitations. First, the sample was a convenience one, and most of the pupils were from one school that has a high socioeconomic level, so it will be difficult to generalize the findings. Another limitation is the fact that the experiment did not examine working memory performance in a natural learning environment, such as a class lesson.

We suggest that a follow-up study should take place in a more natural learning environment and include more participants. It will also be interesting to compare the results of the same participant and examine his/her working memory with and without distractions. It is recommended that further research would examine the impact of text message distractions on tasks that involve the use of a spatial-visual component as well.

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