Short Videos Viewing Behaviours Have Negative Impact on Undergraduate Students' Visual Short-Term Memory (VSTM) Performance

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Abstract: Visual Short-Term Memory (VSTM) is the ability to retain visual input for a short period of time before being processed by the later memory systems. VSTM is thought to be related to reading ability, which is a major activity of undergraduate student's daily academic activities. The pandemic nurtures the popularity of short videos, particularly in the young population, where they included undergraduate students. While users spend an average 24.5 minutes on short videos every day, the negative impact of short videos is still not clear from a memory perspective. This study plans to investigate how viewing short videos influences VSTM performance by designing a VSTM test using monochrome pattern recognition. Result shows significant difference between experimental group and control group in answering rate ($p = 0.042$), accuracy ($p = 0.027$), and reaction time ($p < 0.001$). Result further suggests that undergraduate participants that attempt the VSTM test after a 5-minute short video watching session showed lower answer rate, lower accuracy, and longer reaction time, suggesting a worse performance comparing to those did not watch short videos before the attempt. An explanation based on the relationship between selective attention and VSTM was proposed. This study is aimed to provide reference for undergraduate student on how the popular short video viewing behaviour can have negative effect on their VSTM, and possibly on their academic activities.

1 INTRODUCTION

The Atkinson-Shiffrin's Modal Model of Memory suggests that external sensory input is first stored in Sensory Memory, with attended memory stored as VisualShort-Term Memory (VSTM)(Atkinson, Shiffrin 1968). One type of Short-Term Memory that temporarily stores visual information is Visual Short Term Memory (VSTM) (Luck 2007). Unlike the sensory storage, which has a high capacity, related to the spatial position, maskable, and brief, VSTM is not tied to spatial position, protected against masking, and degenerates after a few seconds (Newhagen, Reeves 1991).

Since VSTM receives visual input from sensory memory and stores the visual information for further cognitive processing, it is shown to facilitate character recognition, driving, and recognizing passing by objects, which are all vital to one's normal function in daily life (Curby, Gauthier 2007, Koyama, Stein, Stoodley, Hansen 2011, Reimer, Mehler, Wang, Coughlin 2012). More specifically, VSTM is involved in people's reading process, that allows one to receive sensory input from the text, and temporarily store for further processing (Koyama, Stein, Stoodley, Hansen 2011) Interference with VSTM can affect one's performance in daily tasks involving visual information processing, thus impaired one's normal functioning.

Prior research on VSTM has shown that memories are prone to interference from a second irrelevant task (Rademaker, Bloem, De Weerd, Sack 2015). The factor that distracts VSTM is known as a distractor (Rademaker, Bloem, De Weerd, Sack 2015). While older research suggests that VSTM is only vulnerable to distractors containing conflicting information along stimulus of the relevant dimension (Reimer, Mehler, Wang, Coughlin 2012), more recent research has proven that the more a distractor differs from the memory stimuli, the more considerable interference the distractor will cause (Rademaker, Bloem, De Weerd, Sack 2015). Hence, performing a highly irrelevant task before the

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memory task will not only affect but strongly affect the performance of a VSTM test. In this research, short videos are chosen to be the highly irrelevant distractor.

Short videos are becoming increasingly popular as a novel means of entertainment, particularly in Mainland China (website: http://www.bigdata-research.cn/content/202005/1073.html 2021). With a large population of potential customers and the lifestyle changes due to the COVID-19 pandemic, the market scale of short videos in Mainland China has a like-for-like growth of 45.3% in 2020, reaching 62 billion yuan (website: http://www.bigdata-research.cn/content/202005/1073.html 2021). The users spend an average of 24.5 minutes per day on these short video apps, with Douyin(The Chinese Version of TikTok) being their most popular choice (website: http://www.bigdata-research.cn/content/202005/1073.html 2021). Short videos are also popular among undergraduate students, statistics showed that users between the age of 20 and 29 consisted of up 22.4% of the short video users, most of which are in the range of undergraduate students' ages (Statista.com website: https://www.statista.com/statistics/1095186/tiktok-us-users-age/ 2021).

Short videos are usually 15 seconds or 60 seconds long, and users can scroll to the next video if they are not interested in the current ones (Tiktok.com website: https:// www.tiktok.com 2021). The most easily accessible page on Douyin is called #fyp, namely "For You Page," where recommendation algorithms recommend the videos according to the users 'viewing habits. The more the users watch, the more customized the recommendations will be (TikTok website: https://newsroom.tiktok.com/en-us/how-tiktok-recommends-videos-for-you 2021). The viewing of short videos is a consistent reward loop, where the algorithm presents more videos, the user likes to increase the user's watching duration, using positive reinforcement. Users often spend more time than they planned watching short videos (website: http://www.bigdata-research.cn/content/202005/1073.html 2021). During those times, they consistently receive visual sensory inputs, which are considered distractors, and may interfere with their subsequent memory processes, including VSTM.

To our knowledge, there is currently no research on how watching short videos can impact VSTM. Researching how watching short videos consistently affects VSTM can help us better understand how this emerging way of entertainment affects our cognitive functions. Our null hypothesis(h0) is watching short videos would not affect VSTM.

According to the null hypothesis, we have proposed a research hypothesis to reveal the correlation between watching short videos and VSTM. The research hypothesis suggests that if an individual watches short videos for an above-average time consistently, their performance on a VSTM test will worsen.

We will examine the null and research hypothesis by designing and performing a pattern recognition test that assesses the participant's VSTM performance before and after the video-watching behaviour. The pattern recognition test first shows the participant a decorative pattern. After a delay, the participant will be asked to recall the seen pattern by dragging the spectrum to find the decorative pattern they think is most like the seen pattern. The participant will perform the test with and without watching short videos for an above-average amount of time, with a meditation between the sessions. If the research hypothesis is valid, we should see a decrease in VSTM test performance after the video-watching task, comparing to the performance without the video-watching task.

The stimuli are collected and processed from open access patterns available online. The experiment will be programmed through PsychoPy. Data collection will be through PsychoPy. Data analysis will be done using Microsoft Excel and R.

2 METHOD

2.1 Participants

As shown in Table 1, 10 participants (2 males, 8 females; age mean = 19.6 yrs, SD = 0.8) participated in the study. None of the participants reported any neurological or psychiatric disorder; all of them were native mandarin speakers.

Table 1: Prescreening Result for All Participants.

Participant #	Age	Gender	Years of Education	Video	Vision	Hand	Medical Condition	Brain Trauma
1-001	19	Female	13	1h+/Weibo	Y	R	N	N
1-002	20	Female	13	1h	Y	R	N	N
1-003	20	Female	13	3h	Y	R	N	N
1-004	19	Female	13	1h+/Weibo	Y	R	N	N
1-005	19	Female	13	0	Y	R	N	N
2-001	20	Female	13	2h+/Tiktok	Y	R	N	N
2-002	20	Male	14	1h+	Y	R	N	N
2-003	20	Female	13	2h+/Tiktok	Y	R	N	N
2-004	21	Male	14	0	Y	R	N	N
2-005	18	Female	12	10min	Y	R	N	N

Note. Participants are grouped according to their single blinded sorting for their experimental group, with 1-xxx being the control group and the 2-xxx being the experimental group. The "Video" section refers to the participants' daily short video viewing habit, where both time and types of short videos are both recorded. The "Vision" session refers to whether the participants have corrected to normal vision.

2.2 Experimental Procedure

At the beginning of the experiment, subjects were informed of the experimental procedure and they each signed a consent form. The age, gender, handedness, vision, level of education, self-report short video viewing time per day of participants were recorded during pre-screening.

5 of the participants were randomly selected to undergo 5 sets of repeated experimental blocks, during which 5 min of Douyin/TikTok videos were viewed followed by 10 pattern recognition VSTM questions (i.e., a total of 25 min video-watching and 50 VSTM questions). The remaining 5 participants (control group) completed the same experimental procedure but did not watch any videos. The control group was closely monitored by the experimenter to ensure that they did not engage in any attention-demanding activities (e.g., reading, watching videos, replying to messages). All videos were presented from participants 'personal mobile phones due to constraints in experimental condition.

2.3 Short Video Distractors

Short videos are used as distractors and are either 15 s or 60s in maximum length.

To maximally imitate participants 'daily short video experience, we asked participants to watch videos from their most frequently used short video apps. Or if the participant does not have a habit of watching short videos, we asked them to view videos from a blank account on Douyin (the most popular short video app in Mainland China) to ensure a relative unbiased video selection.

2.4 VSTM Test

Following each video viewing period (experimental group) or rest period (control group), a VSTM test is used as the secondary task procedure.

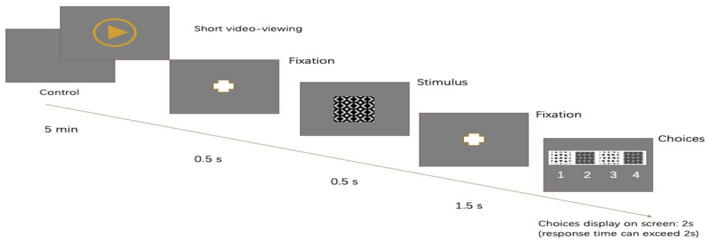

Figure 1 Scheme of The VSTM Test For Both Control And Experimental Group.

As shown in Figure 1, the monochrome pattern was shown for 0.5s. There was a fixation for 0.5s before the correct pattern. After the patter was shown for 0.5s, there was another fixation for 0.5s, and later participants tried to identify the shown pattern from 4 choices presented choices. The choices were available for 1.5s.

Both groups response were recorded, correctness rate and verbalized response time recorded.

Since verbalized response time required manual recording, we conducted a single-blind experiment where the experimenter who did the recording was kept unaware of whether a subject belongs to the experiment group or control group in order to prevent biased data.

A pattern recognition STM test was performed on each participant as a secondary task procedure. The participants were briefly shown a monochrome pattern for 500ms before trying to identify the given pattern in the following multiple-choice questions. Participants were instructed to pay close attention to the test. Participants 'reaction time and accuracy were recorded for data analysis as supported by prior studies (Newhagen, Reeves 1991).

3 RESULTS

3.1 Measurements

The collected data was evaluated from three aspects: the answering rate, the correctness rate, and the reaction time. The answering rate refers to the response the participants provided divided by the total trials available (n = 50). The accuracy refers to the correct choices made divided by the total number of trials (n = 50). The response time was recorded by the PsychoPy data collection function and extracted from its .csv file.

Table 2 Results For Answering Rate, Correctness Rate, and Average. Time.

	Control group participants							
	1-001	1-002	1-003	1-004	1-005	mean	SD	SEM
Answering rate	0.94	0.94	0.98	0.92	0.98	0.952	0.024	0.012
Correctness rate	0.8	0.84	0.9	0.86	0.98	0.876	0.061	0.031
Avg. Time	2.14	2.14	2.15	2.26	2.27	2.192	0.060	0.030
	Experimental group participants							
	2-001	2-002	2-003	2-004		mean	SD	SEM
Answering rate	0.72	0.96	0.9	0.8	0.86	0.848	0.083	0.041
Correctness rate	0.68	0.84	0.8	0.78	0.7	0.760	0.061	0.030
Avg. Time	2.49	2.43	2.32	2.41	2.56	2.442	0.080	0.040

Table 3: P-Values For Answering Rate, Correctness Rate, and Average Time.

	P-value
Answering rate	0.042
Correctness rate	0.027
Avg. Time	0.001

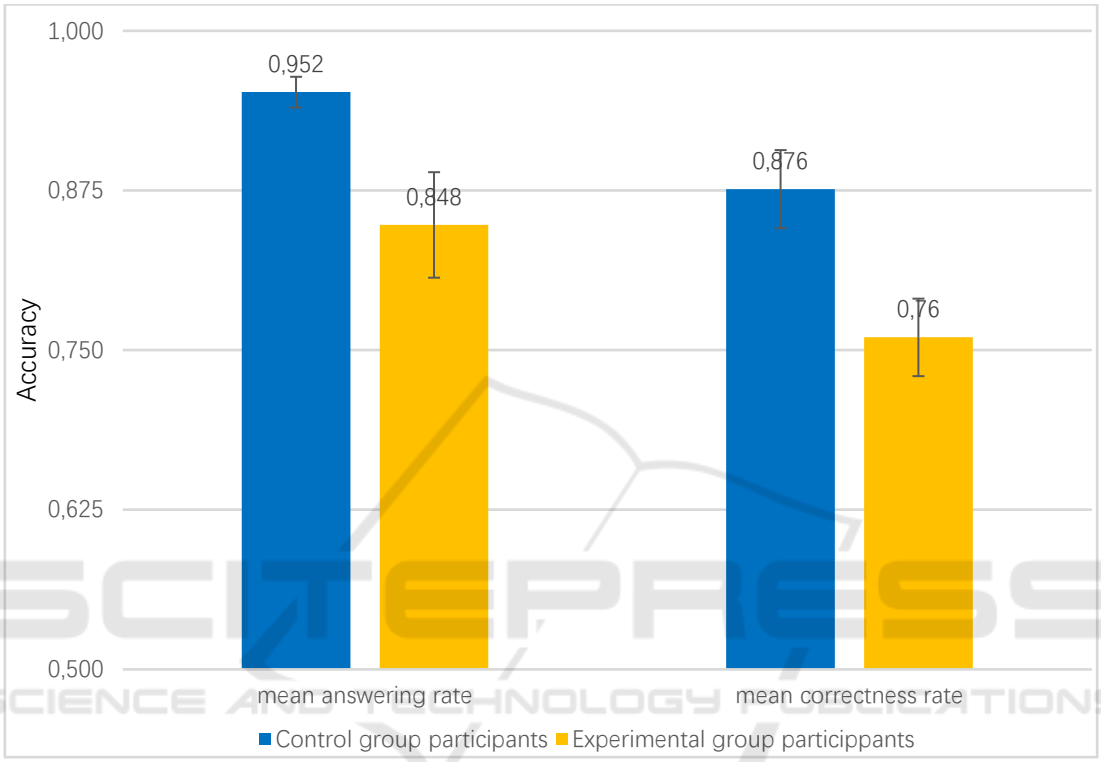

Figure 2: Comparison of Mean Answering Rate and Mean Correctness Rate.

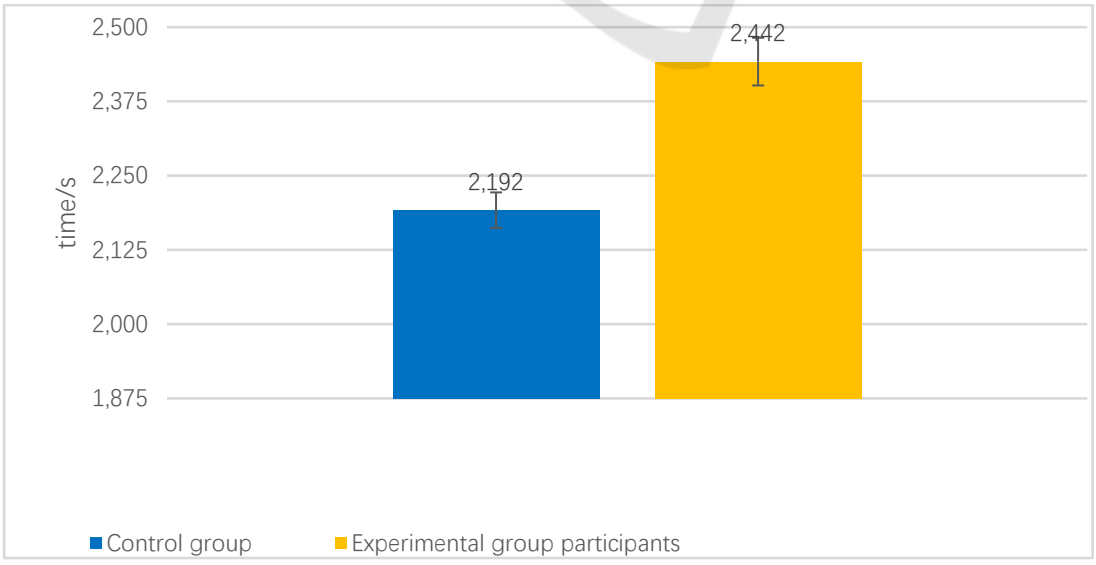

Figure 3: Comparison of Mean Reaction Time.

3.2 Answering Rates

The answering rate is how many trials can the participant provide an answer in a given time interval of 3.5s. Shown in Table 2, the control group participants who did not watch any short videos had an average answering rate of 0.952 (SD = 0.024, SEM = 0.012), and the experimental group who watched 5 minutes of short videos before each sessions had an average answering rate of 0.848 (SD = 0.083, SEM = 0.041). Shown in Figure 2, the mean answering rate for control group was higher than the experimental group. As shown in Table 3, the calculated p-value using unpaired two tailed t-test showed that the p-value for answering rate between the control and the experimental group is 0.042, the alpha value in this study was set to 0.05.

3.3 Correctness Rate

The correctness rate refers the number of questions each participants answered correctly comparing to the questions. As shown in Table 2, the control group had an average correctness rate of 0.876 (SD = 0.061, SEM = 0.031) and the experimental group showed an average correctness of 0.760 (SD = 0.061, SEM = 0.030). Shown in Figure 2, the control group has a higher average correctness rate comparing to the experimental group. Using unpaired two tailed t-test, the p-value for answering rate between the control and the experimental group is 0.027, with an alpha value of 0.05 for this study, as shown in Table 3.

3.4 Reaction Time

As recorded by the PsychoPy program, the reaction time shows how fast does the participants response to the choices. Shown in Table 2, the mean reaction time is 2.192s for control group (SD = 0.060, SEM = 0.030), and 2.442s for experimental group (SD = 0.080, SEM = 0.040). Figure 3 shows a shorter mean reaction time for control group comparing to experimental group. The calculated unpaired two tailed t-test result shown in Table 3 shows that the p-value for reaction time is less than 0.001, and this study applies an alpha value of 0.05.

4 DISCUSSIONS

4.1 Discussion: Short Video Viewing Behaviour Has a Negative Impact on VSTM Performance

Despite being a rising form of entertainment, there has been little to non-research on how short-video viewing behaviour affects VSTM, which is important to reading (Koyama, Stein, Stoodley, Hansen 2011). The participants in this round of experiment are all undergraduate students, meaning that the discussion can be narrow down to the population of undergraduate students. In this population of 10 participants, there are significance shown in all three measured aspects including answering rates, correctness, and reaction time.

For answering rates, since the alpha value is 0.05 and $p = 0.042$, the p-value is smaller than the alpha value, meaning that there is a significant difference for answering rates between participants in experimental group and control group. The plotted graph also shows that the experimental group, shows lower answering rate comparing to control group. The significance implies that participant who watch five minutes of short videos for each session, a total of 25 minute of short video, will show less answering rate when responding to VSTM tests.

For correctness, the alpha value is 0.05 and the calculated $p = 0.027$, the p-value is smaller than the alpha value. The significance means that there is a significant difference for correctness between experimental group and control group. With the correctness of experimental group being lower, this study reveals that watching short videos on a daily average time can have a negative impact on VSTM's accuracy.

For reaction times, the alpha value is 0.05 and the calculated $p < 0.001$. The p-value is smaller than the alpha value. This result means that if the participant watches short videos before each of the trials, they will react slower to presented stimulus that test their VSTM performance. Moreover, when performing VSTM related tasks, they tend to perform slower than others who have not watched short videos prior to the tasks.

Since the experimental group, which are participants that watched short-videos prior to the trials, showed lower answering rate, correctness, and longer reaction time, this study can conclude that short-video viewing has a negative impact on undergraduate student's VSTM performance.

4.2 Conclusions

Undergraduate students spend an average of 6.5 hours on their daily activities, which most of the time are spent on reading (St Clair-Thompson, Graham, Marsham 2018). Since the reading activity is heavily emphasized in undergraduate students' academic life, interruption on VSTM, the reading-related memory can imply negative outcome of reading activities.

Prior research has shown VSTM disruption by selective attentional disruption (Makovsik, Jiang 2007). Makovski et al. performed an experiment to prove that if attention is shifted from a distributed mode to a focused mode, the VSTM performance increased (Makovsik, Jiang 2007). This previous research showed a relationship between VSTM and attention. When the participants are viewing short videos, the short videos are considered sensory inputs, and according to the Atkinson-Shiffrin's Modal Model of memory, the visual input are stored in sensory memory and later filtered by attention to store in the VSTM. In the case where experimental groups are viewing short videos, if a further experiment can be performed to verified that the participant's attention is in a disrupted state, then it would be possible to verify the result by Makovski et al.

From an application perspective, this study has provided a result showing that the popular activity of short video viewing has an impact on VSTM, which is an academic-activity-related form of memory. The result can provide reference for short video application users, especially undergraduate students, parents, universities, and the short video application companies.

4.3 Limitations and Future Directions

The sample size of this study is limited and there is an unequal distribution of gender. The experiment was designed to run online, but due to time and device limit, and the social gathering restrictions, the experiment was run in an alternative form and run online using zoom and reaction time was recorded using verbal response from participants. Also, there is an ambiguous requirement of short videos viewing. Some participants from the experimental group are observed scrolling the short videos consistently, while others finish watching each video to the end.

As a result, more data gathering is needed in the subsequent stages of research, and more analysis can be done once data size is sufficient. Since short videos is a brand-new form of media, study how the content and structure of short videos influences VSTM performance is also considered a next step. Possible neuroscientific studies like EEG and fMRI can be combined with behavioural test to reveal more biological evidence to support the gathered data.

REFERENCES

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), Psychology of Learning and Motivation (Vol. 2, pp. 89–195). San Diego, CA: Elsevier.

Curby, K. M., & Gauthier, I. (2007). A visual short-term memory advantage for faces. Psychonomic Bulletin & Review, 14(4), 620–628.

Douyin's User Activities Dramatically Increased During COVID-19. (n.d.). Retrieved May 28, 2021, from Bigdata-research.cn website: http://www.bigdata-research.cn/content/ 202005/1073.html

Koyama, M. S., Stein, J. F., Stoodley, C. J., & Hansen, P. C. (2011). Functional MRI evidence for the importance of visual short-term memory in logographic reading: Logographic reading and visual short-term memory. The European Journal of Neuroscience, 33(3), 539–548.

Luck, S. (2007). Visual short term memory. Scholarpedia Journal, 2(6), 3328.

Magnussen, S., Greenlee, M. W., Asplund, R., & Dyrnes, S. (1991). Stimulus-specific mechanisms of visual short-term memory. Vision Research, 31(7–8), 1213–1219.

Makovsik, T., & Jiang, Y. V. (2007). Distributing versus focusing attention in visual short-term memory. Psychonomic Bulletin & Review, 14(6), 1072–1078.

Newhagen, J., & Reeves, B. (1991). Effects of compelling visual images on attention to and memory for new stories. Paper presented to the International Communication Association, Chicago

Phillips, W. A. (1974). On the distinction between sensory storage and short-term visual memory. Perception & Psychophysics, 16(2), 283–290.

Rademaker, R. L., Bloem, I. M., De Weerd, P., & Sack, A. T. (2015). The impact of interference on short-term memory for visual orientation. Journal of Experimental Psychology. Human Perception and Performance, 41(6), 1650–1665.

Reimer, B., Mehler, B., Wang, Y., & Coughlin, J. F. (2012). A field study on the impact of variations in shortterm memory demands on drivers' visual attention and driving

St Clair-Thompson, H., Graham, A., & Marsham, S. (2018). Exploring the reading practices of undergraduate students. Education Inquiry, 9(3), 284–298.

TikTok - make your day. (n.d.). Retrieved May 28, 2021, from Tiktok.com website: https:// www.tiktok.com

TikTok user ratio in the U.S. 2021, by age group. (n.d.). Retrieved June 25, 2021, from Statista.com website: https://www.statista.com/statistics/1095186/tiktok-us-users-age/

TikTok. (2020, June 18). How TikTok recommends videos #ForYou. Retrieved May 28, 2021, from TikTok website: https://newsroom.tiktok.com/en-us/how-tiktok-recommends-videos-for-you