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The New Educational Review

Social Media and Task Performance: Does Being Online distract task completion?

DOI: 10.15804/tner.2022.67.1.19

Abstract

At present, social media are connected with education. Both influence daily life and studying since they impact formal and informal relations. This study explores the role of social media in task performance. Based on Mackworth's clock test, we experimented with university students (N=54), which assessed their capacity to concentrate on the task when exposed to notifications from social networking. We explored whether the appearance of social media notifications regarding different stimulus properties (i.e., sound and vision) lowered cognitive resource capacity to concentrate on the main task. The findings revealed that the mere presence of notifications affected task performance. However, the focal relationship was more complex.

Keywords: *social media notifications, attention, task performance, university students.*

Introduction

The COVID-19 pandemic has resulted in worldwide educational change. With the sudden and global shift from on-site learning to e-learning, students spend more time with computers and the Internet since e-learning strengthens the use of social networking. Usage rates are relatively high among undergraduate college

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students – 66.2% of them use it daily for at least 51 minutes (Smith et al., 2009). Recent statistics showed that 3.8 million people worldwide use social media for an average of 145 minutes per day, with the daily rate from 1 hour 15 minutes in Europe to 3.5 hours in South America (Statista, 2020). This study contributes to the research on the role of the Internet in higher education concerning students' ability to concentrate on task-related activity when exposed to social media notifications in the education process. Based on cognitive processes, individuals are characterized by a finite capacity for cognitive processing (Wickens, 2017), which influences their everyday behavior, e.g., learning. Students are regularly exposed to potentially meaningful information, e.g., notifications from social media that appear on the main screen. Yet, their cognitive systems can attend and process only a small amount of the information that appears to them, which minimizes their ability to use available information (Wickens, 2021). Due to the limited capacity of cognitive systems, the attentional resources used for one cognitive task reduce the resources available for other tasks. Thus, the question arises: are students able to concentrate their attention on the main task while exposed to social media notifications? To answer this question, we applied a cognitive experiment among university students. In this study, we explored whether the appearance of social media notifications regarding different stimulus properties (i.e., sound and vision) lowered cognitive resource capacity to concentrate on the main task. In the present study, we focused on the insufficiently analyzed situation when social networking was not in use but was merely present, i.e., the notification settings allowed for receiving and displaying notifications and sounds on the computer screen.

Research Methodology

General Background of Research

The use of social networking sites is common, especially among students. 69% of all Internet users and 99% of individuals aged 18–24 years have social media accounts (e.g., Facebook, Twitter). As declared (CBOS, 2020), youngsters and young adults, including students, who are almost permanently online, receive information on an ongoing basis and react to messages. Facebook is still one of the most popular social networks worldwide, as ranked by the number of active users (Statista, 2020). Considering the current popularity of Facebook among university students, we focused on the focal social network in this study. Since learning can be formal and informal, social media have become an important tool in higher education.

Research has shown that selective attention determines whether a person performs a given task successfully (Lodge & Harrison, 2019). When exposed to a distracting stimulus, task completion may depend on the complexity and structure of the stimulus – the more complex and distinguishable the stimulus, the greater the likelihood for its analysis. Thus, attention is likely to switch from the primary task to distractors. The obtained results related to task completion are lower since the central processing has a limited capacity. Yet, the central processing capacity is crucial when two or more events require processing, e.g., dual-tasking (Hirsch et al., 2019). In the group of students, social media notifications during task completion might change the fixation from the task to the appearing stimuli, thus running the resource allocation. Therefore, they can distract from task performance. Involuntary attentional processes are attracted continuously by the physical properties of the distractors (priority characteristics), and hence the constant competition between intentional (on-task activity) and unintentional (off-task activity) attentional processes in cognitive resource allocation (Lodge & Harrison, 2019). Learning suffers if the student is looking at the wrong signal, e.g., a picture on the website, which reflects some failure in attention. The attentional cost of receiving notifications indicated that awareness of a missed message decreased the performance of tasks that required persistent attention and vigilance. In other words, received notifications are likely to induce notification-related and task-unrelated thoughts (Isikman et al., 2016).

Considering that, we assumed that exposure to social media notifications would distract students, thus decreasing their concentration on the main task. Based on vigilance and signal detection theory (Giambra et al., 2013), we assumed that students would perform fewer hits, more incorrect reactions, and longer reaction time. Moreover, the specific physical properties of the stimulus (i.e., visual vs. audiovisual notifications) would differentiate between the results and the on-task concentration. Therefore, we hypothesized as follows:

Hypotheses 1: Notifications from social media (i.e., Facebook) distract students' ability to concentrate: individuals exposed to notifications during the task performance obtain lower results (i.e., number of hits, false alarms, reaction time) than individuals who are not exposed to notifications.

Hypotheses 2: Different physical properties of the social media notifications (i.e., visual and audiovisual) result in differences between the experimental and control groups regarding a concentration on the main task.

Hypothesis 3: Daily social media usage is related to task performance within groups when exposed to social media notifications.

Sample of Research

The study participants were students from one of the Polish universities. Women constituted 50% of the sample, and the mean age was M=22.5 years (SD=0.93, age range 20–24 years). The respondents reported that the daily time of social media usage was mostly three to six hours (50%) or more (14.8%). 25.9% spent one to three hours per day, while only 9.3% of the sample spent less than one hour per day on social networking sites. Based on Mackworth's study, we did not use the screening criteria for selecting the participants except for being a student (Mackworth, 1984). The cross-sectional sample of 54 participants was partitioned into three groups regarding the physical properties of the distracting stimulus, i.e., the visual group (G1), the audiovisual group (G2), and the control group with no distraction (Gc). Each group comprised 18 participants (nine men and nine women).

Instrument and Procedures

Mackworth clock test was used to test the concentration on the task (Mackworth, 1948). We used the computer-based version (Lichtstein et al., 2000) of the PsyToolkit (Stoet, 2010; 2017).

Demographics. Age, gender, and daily social media usage were assessed as control variables. The participants were asked about their time using social media a day (i.e., less than 1 hour, 1–3 hours, 3–6 hours, and more than 6 hours). Gender was dummy coded with 0=female and 1=male.

Main task. All participants were asked to perform the Mackworth clock test. First, they were asked to consent to participate in the study voluntarily. Before the test session, they were asked to complete basic personal data, e.g., age, gender, and the time spent on social networking. Next, they were asked to perform the Mackworth clock test. We used the program that duplicates the initial form and procedures of the test (Lichstein et al., 2000). The program uses a clock hand on a blank background. The second hand is triangular with a base of 0.5 cm and a length of 3 cm. The hand advances in discrete steps every second, and a group of 100 steps completes the circle. The test was preceded by instruction, demonstration, and practice. The same instruction was given to all participants. Their task was to watch the clock hand and press the bar space if it moved more than usual. Otherwise, they were asked to keep watching the movement of the clock hand. The clock test ran for 15 minutes. The 15-minute interval was chosen on a theoretical basis, i.e., previous experiments had revealed the highest vigilance during the first half-hour (Macworth, 1948). To minimize the time effect lowering the vigilance during the prolonged visual task, we tested the effect of distractors (notifications

from social media) on concentration on the main task when all groups were fresh to work. The participants were asked to press the space bar as soon as one of the signals occurred. If the space bar was depressed within one second after the occurrence of the signal, it was recorded as a hit. A signal followed by one second without a response was scored as a miss, and a response that was not preceded by a signal within one second was scored as a false alarm. The participants were given immediate feedback while performing the task: the red light was used as an error signal and occurred when the space bar was pressed in the case there was no unusual clock hand movement, or there was a failure to detect it, whereas the green light was considered the positive feedback and occurred in the case of the correct reaction. After 15 minutes, the test session was automatically stopped, and the summarized results appeared on the screen. The brief feedback included the number of total tics, missed skips, and wrongly detected skips.

Notifications from social media. We used the notifications from one of the most frequently used social networks among students, i.e., Facebook. The content of the notifications was the same for both groups, G1 and G2. G1 was exposed to the visual content only. In the case of G2, the visual messages appeared with a short audio signal. The notifications were in the form of a short conversation between students, but the content was tailored to the focal group and referred to the upcoming semester test. The notification window automatically appeared on the bottom right corner of the computer screen, controlled by an auto-clicker. The Google Chrome browser was used to open the previously scheduled conversation on Facebook so that the program could send it at a set time. The notification frequency was the same for G1 and G2. We started the first signal in the second minute of the session. The next four stimuli appeared every 15 seconds. Another message was presented after 30 seconds, and the last message was given after one minute. Then, the frequency was repeated. We used different time intervals between distracting stimuli to avoid the learning effect (Wingenfeld et al., 2006).

The sessions were conducted individually for each participant. During the entire session, the participants sat comfortably in front of the computer screen, positioned approximately 50–100 cm from their eyes (Lichstein et al., 2000). The test was performed in a quiet and moderately lit room to minimize the disruption. All participants were volunteers. They were informed about the anonymity of data collection and the aim of the study, i.e., concentration on task completion (vigilance test). Prior to participation, they had been informed about the possibility of withdrawing their consent at any time and without any consequences. The current study was conducted with the approval of the Ethics Committee at the University of Silesia in Katowice.

Results

Table 1 shows the means and standard deviations for three performance measures, i.e., hits, false alarms, and reaction time. The first measure (hits) was the number of correctly detected double-length movements of the second hand. The second measure (false alarms) comprised the total number of incorrect presses of the response key when a single movement was mistaken for the target. The last measure (reaction time) was the mean reaction time for all detected targets (scored in seconds). The reaction time was calculated as an interval from the double-length movement to the press of the response button.

Table 1. Means (M) and standard deviations (SD) for hits, false alarms, and reaction time

	Total Sample		Gc		G1		G2	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Hits	60.74	17.75	58.77	19.83	60.38	16.06	63.05	17.94
False alarms	21.46	21.12	18.88	12.41	20.05	9.54	25.44	33.47
Reaction time	.56	.04	.55	.03	.57	.03	.56	.06
N	54		18		18		18	

Note. Gc=control group with no exposure to stimuli from social media; G1=sample exposed to visual stimuli; G2= sample exposed to audiovisual stimuli

As shown in Table 1, the mean number of hits was 60.74. The mean number of false alarms was 21.46, and the mean reaction time was 0.56 sec. The same data were separately partitioned into the group that received no notification from social media (Gc) and groups exposed to visual (G1) or audiovisual (G2) notifications. The results showed the highest number of hits in G2, while the lowest number was found in Gc. In the case of false alarms, the highest rate of incorrect presses was found in G2, while the lowest rate was observed in Gc. The quickest reaction time was found in Gc. However, G1 needed more time to react to signals. The mean differences partially confirmed our first hypothesis. As hypothesized, the experimental groups exposed to social media notifications differed in terms of reactions to the signal from the main task compared to Gc without exposure to distractors.

One-way ANOVA was used to test whether the exposure to notifications from social media impacted concentration on the main task. Tests for the main effects of groups for hits, $F(2, 51)=.259$, false alarms, $F(2, 51)=.484$, and reaction time,

F(2, 51)=.249 were nonsignificant. Therefore, the results did not support our second hypothesis about significantly lower scores related to concentrating on the task in the groups exposed to stimuli with different physical properties (visual *vs.* audiovisual).

Additionally, we investigated the effect of daily social media usage on the clock task performance (Figure 1). One-way ANOVA showed the lowest number of hits among the users who spent 1–3 hours per day on social networking (M=0.55, SD=0.04), and the highest number of hits in the group using social media for more than six hours per day (M=0.55, SD=0.06) compared to students who used social media for less than one hour (M=0.58, SD=0.04) and 3–6 hours per day (M=0.57, SD=0.04). The pairwise comparisons showed that students who used social networking for 3–6 hours had a significantly higher mean of hits than students who used social media for 1–3 hours (d=10.106, p<0.10). Furthermore, individuals who reported daily social media usage for more than six hours had a significantly higher mean of hits than those who used social networking for 1–3 hours (d=16.267, p<0.05). The differences between the mean yield of other samples and reactions to the target (false alarms and reaction time) were statistically nonsignificant.

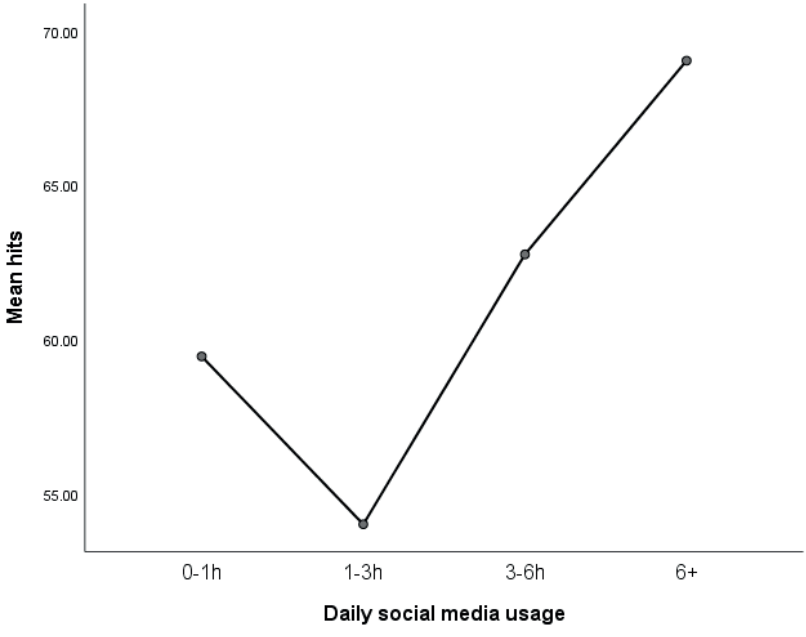

Figure 1. Means' difference of correct responses (hits) for students with different social media daily usage

Next, the data were broken down separately for men and women. ANOVA was used for the following interaction: gender (men *vs.* women) x social media usage time (less than 1 hour, 1–3 hours, 3–6 hours, and more than 6 hours) to test hits, false alarms, and reaction times. The results yielded a significant interaction for hits in Gc $F(1,12)=7.68$ ($p=.017$ $\eta^2=.39$). The pairwise comparisons showed that female students who used social media for 1–3 hours daily had a higher mean of hits than male students ($d=12.5$). However, females who used social networking for 3–6 hours per day had a lower mean of hits than male students ($d=31.8$). The investigated effect was insignificant in other experimental settings. Thus, we partially confirmed our assumption about the relationship between social media daily usage and task performance when exposed to different distractors.

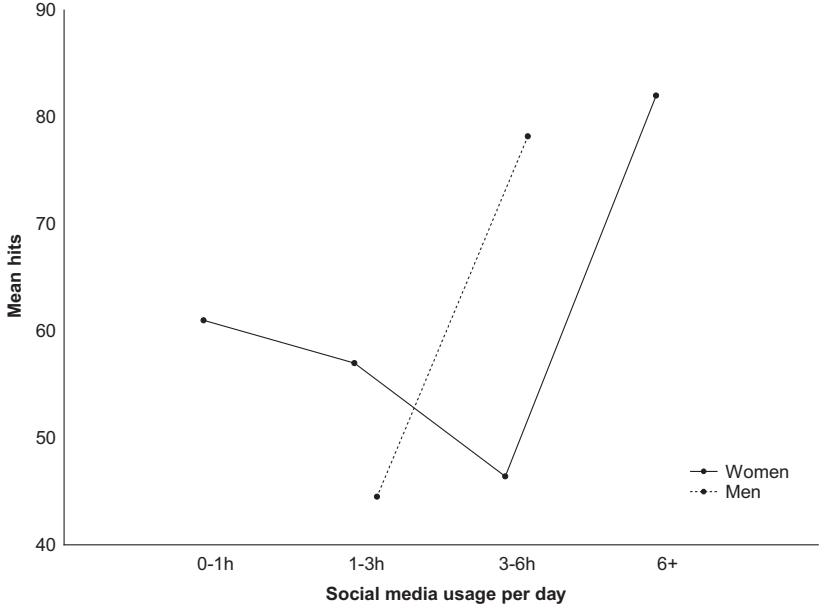

Figure 2. Means' difference of correct responses (hits) for female and male students with different social media daily usage

Discussion

Our study confirmed that students with no exposure to distractors (social media notifications) showed the lowest number of incorrect presses (false alarms), and their reaction time was faster than those with exposure to distractors. According to the attention theory (Lien et al., 2010), when participants were involved in one-task performance, they did not need to allocate their cognitive resources. In turn, students exposed to visual and audiovisual distractors obtained extended reaction times. Studies on mobile devices and cognitive capacity (Caird et al., 2008) revealed that the use of mobile devices while driving was related to performance deficits, such as delayed reaction time. Accordingly, our results indicated that attention was automatically switched from the primary task to notifications, which resulted in delays in students' reactions. Yet, the delay in responses was the highest in the group exposed to visual conditions. High-priority stimuli capture the attention of individuals and lead to cognitive costs related to the inhibition of this automatic attention response. The research on controlled and automatic processing (Wingenfeld et al., 2006) showed that the personally relevant stimuli lowered performance on cognitive tasks, even without conscious attention to the potentially interfering stimuli. Moreover, cognitive deficits also occur due to unconscious inhibition of interfering stimuli (Wickens, 2021). Therefore, the appearance of visual stimuli can lower the cognitive capacity, irrespective of whether or not individuals control the conscious orientation of their attention on the primary task.

Our study revealed that incorrect reactions (false alarms) occurred more frequently in groups under experimental settings. Based on stimulus-driven theories (Gaspelin & Luck, 2018), physically salient (i.e., noticeable) stimuli capture attention, regardless of the observer's intention. Social media notifications attract users' attention to a new private message or social media comment, thus drawing their attention away from the performed task. The limited resource model of attention shows the amount of attention allocated to an item as a function of how much overall processing is required in a task (Wickens, 2021).

Contrary to our assumption, students who received notifications from social media, particularly audiovisual messages, achieved the highest number of hits. Considering the higher rate of incorrect responses, the higher frequency of correct reactions might be random. However, task completion is possible since the individuals are volitionally trained to facilitate their vision and behavior (Drigas & Karyotaki, 2019). In the Perceptual Template Model (Lu & Dosher, 1998), attention to visual tasks is predicted by the signal enhancement mechanism, distractor exclusion, or internal noise suppression. The individual decision about attention

orientation is based on detection or discrimination. Only stimuli that match the right features of the search target capture attention (Lien et al., 2010). In our study, students followed the instruction to focus their attention on the clock hand. Therefore, salient distracting stimuli did not attract their attention. Even though physically salient stimuli attract attention, inhibitory processes can suppress them as a component of cognitive control (Gaspelin & Luck, 2018). Thus, the inhibitory mechanism can suppress the salient stimuli that otherwise automatically capture attention. A student might learn that visual stimuli appeared together with sound. Therefore, hearing the sound can activate the inhibitory mechanism. In other words, the sound became a signal to suppress the automatic reaction to switch the attention from the task-related activity.

In the next step, we tested for the effect of daily social media usage on the clock task performance. The results indicated that students who were more dependent on the social networking activity, i.e., spent more time using social media per day, showed better task performance. The focal group showed a higher rate of correct presses (hits). Additionally, the results yielded a significant interaction between daily social media usage and gender in the group without exposure to notifications from social media. Male students who spent more time on social networking showed a higher mean of hits than female students. Although the vast majority of research on gender differences (in Hirsch et al., 2019) indicated that women performed better in the situation of multitasking, some studies (Mantyla, 2013) found higher costs of multitasking performance in this group. In the dual-task involving monitoring the digital clocks, men achieved better monitoring accuracy.

Several potential limitations of the present research should be mentioned. First, the data were obtained from a relatively small sample. However, Mackworth's (1948) original experiment was provided to three samples of 25 participants each. We recruited 54 volunteers, who were university students, and partitioned them into three experimental groups of 18 individuals each. Second, the sample size could result in the fact that the group differences were not statistically significant. However, the results revealed important tendencies. Further studies should include a higher number of participants.

Conclusions

Our study makes several contributions to our understanding of social media usage in the context of education, particularly in terms of task performance. The results outlined the influence of receiving notifications from social networking on

task-related activity. Of note, exposure to notifications (distractors) was related to a better task performance connected with a lower number of false alarms and faster reactions to signals. Our findings, however, revealed a complex relationship between the stimuli from social media and on-task activity. Students exposed to signals from social media performed better on the task related to correct reactions, which was reflected by a higher number of correct presses. Furthermore, the number of hits was higher among students exposed to audiovisual notifications and those who spent more time on the daily usage of social media.

To conclude, our study indicated the potential costs of integrating social media into the learning process when the students needed to concentrate on a specific task with high attention requirements. The mere presence of social media notifications, even unrelated to a person or a current task, affected the attention capacity to concentrate on a specific task. Although students exposed to distracting information from social media could complete the task correctly, their performance was poorer in terms of reactions and time. Thus, regardless of concentrating on the task and keeping social networking notifications out of conscious attention, these stimuli still influenced the attentional resources allocated to the main task and lowered them.

References

Caird, J. K., Willness, C. R., Steel, P., & Scialfa, C. (2008). A Meta-Analysis of the Effects of Cell Phones on Driver Performance. *Accident Analysis and Prevention, 40*, 1282–1293.

CBOS. (2020). Internet usage. Research Report. https://www.cbos.pl/SPISKOM.POL/2020/K_085_20.PDF

Drigas, A., & Karyotaki, M. (2019). Attention and its Role: Theories and Models. *International Journal of Emerging Technologies In Learning (IJET), 14*, 169–182. DOI:10.3991/ijet.v14i12.10185

Gaspelin, N., & Luck, S. J. (2018). The Role of Inhibition in Avoiding Distraction by Salient Stimuli. *Trends in Cognitive Sciences, 22*, 79–92. DOI: 10.1016/j.tics.2017.11.001

Giambra, L., Quilter, R., Phillips, P. & Hiscock, B. (2013). Performance on a sustained attention task as a function of strategy: A cross-sectional investigation using the Mackworth clock-test. *Bulletin of the Psychonomic Society*, 26, 333–335. DOI: 10.3758/BF03337673

Hirsch, P., Koch, I., Karbach, J. (2019). Putting a stereotype to the test: The case of gender differences in multitasking costs in task-switching and dual-task situations. *PLoS ONE, 14.* DOI: 10.1371/journal.pone.0220150

Isikman, E., MacInnis, D. J., Ülkümen, G., & Cavanaugh, L. A. (2016). The Effects of Curiosity-Evoking Events on Activity Enjoyment. *Journal of Experimental Psychology: Applied, 22*, 319–30.

Lichstein, K. L., Riedel, B. W., & Richman, S. L. (2000). The Mackworth Clock Test:

A Computerized Version. *The Journal of Psychology: Interdisciplinary and Applied, 134*, 153–161. DOI: 10.1080/00223980009600858

Lien, M. C., Ruthruff, E., & Johnston, J. C. (2010). Attentional capture with rapidly changing attentional control settings. *Journal of Experimental Psychology: Human Perception and Performance, 36*, 1–16. DOI: 10.1037/a0015875

Lodge, J., & Harrison, W. (2019). The Role of Attention in Learning in the Digital Age. *The Yale Journal of Biology and Medicine, 92*, 21–28.

Mackworth, N. H. (1948). The breakdown of vigilance during prolonged visual search. *Quarterly Journal of Experimental Psychology, 1*, 6–21, DOI: 10.1080/17470214808416738

Mantyla, T. (2013). Gender differences in multitasking reflect spatial ability. *Psychological Science, 24*, 514–520. DOI:10.1177/0956797612459660. PMID: 23462757

Stoet, G. (2010). PsyToolkit: A software package for programming psychological experiments using Linux. *Behavior Research Methods, 42*, 1096–1104. https://doi.org/10.3758/BRM.42.4.1096

Stoet, G. (2017). PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. *Teaching of Psychology, 44*(1), 24–31.

Statista. (2020). Social Media & User-Generated Content. https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/

Wickens, C. (2021). Attention: Theory, Principles, Models and Applications, *International Journal of Human–Computer Interaction, 37*, 403–417. DOI: 10.1080/10447318.2021.1874741

Wingenfeld, K., Bullig, R., Mensebach, C., Hartje, W., Driessen, M., & Beblo, T. (2006). Attention bias towards personally relevant stimuli: the individual emotional Stroop task. *Psychological Reports, 99*, 781–793. DOI:10.2466/pr0.99.3.781-793. PMID: 17305196.