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Social media use while listening to new material negatively affects short-term memory in college students

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ABSTRACT

Increased access to electronic devices and the ubiquity of social media has resulted in a rapid rise in the prevalence of students "multitasking" while in a classroom setting. While some data indicate the use of electronic devices in class can improve the classroom environment, other studies demonstrate the opposite finding. Moreover, it remains unclear if using social networking sites such as Instagram impacts performance on cognitive tasks when students are presented new material and, if so, what features of Instagram modulate this response. Therefore, in the current study we examined if social media use during or after being presented new information affected short-term memory in college students. Additionally, we assessed if the type or quantity of topics displayed had a modulatory impact on memory. Forty-five college-aged (18–24 years of age) students completed the Logical Memory Immediate Recall (LM I) component of the Wechsler Memory Scale IV, a measure of auditory recognition memory. Subjects were randomly divided into a group that completed the LM I without distraction (controls), a group that completed the LM I while scrolling through their Instagram feed, or a group that completed the LM I after scrolling through their Instagram feed. Subjects that used Instagram while being presented new information demonstrated worse short-term memory recall ability compared to subjects that did not use Instagram during the presentation (71.56% correct answers vs. 80.89%; $p = 0.01$). Recall ability in the group that used Instagram after hearing the story was not statistically different from the controls. Differences were not observed in the number of topics appearing in subjects' Instagram feeds and no correlation was found between the number of topics on a subject's Instagram feed and memory recall ability. Collectively, these results suggest that individuals who use their phones to browse Instagram during class or in social settings might have a reduced ability to retain the information given to them when compared to those that are not using their phones scrolling on social media.

1. Introduction

Increased access to electronic devices over the past twenty years has resulted in a rapid rise in individuals performing multiple different tasks simultaneously [27, 32]. Although using electronic devices for "multitasking" (i.e., the parallel use of several media alone or in combination with nonmedia activities) has become profoundly more convenient and accessible to the general public, the availability and widespread use of electronic devices has also created a mechanism for distraction from cognitive tasks [27]. Various forms of electronic devices such as laptops, tablets, and smart phones are now regularly encountered in the college classroom [17] and educators are increasingly concerned about the impact these devices might have on learning [15, 27].

A growing body of literature indicates that the use of electronic devices in the classroom and multitasking can have a negative impact on learning. For example, a negative correlation has been found between laptop use in a large-lecture course environment and students' performance [15, 49]. Additionally, when students reported what distracted them in class, laptop use by other students represented the majority of distractions [15]. Similarly, students who used laptop computers performed poorer on both short-answer and multiple-choice questions when tested on the material following a lecture presentation compared to students who did not use laptop computers during lecture [19]. Moreover, the movement and lighting of text and pop-up messages in laptops has been found to reduce performance and increase the number of errors [42]. Students' use of phones in the classroom has also been reported to distract both faculty and other students, resulting in

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policies created by instructors to attempt to reduce cell phone use during class time [4, 5, 7, 9, 17]. Interestingly, one study found that the mere presence of a cell phone, even when participants were not using it, can reduce cognitive capacity [45].

Conversely, while multiple studies found a negative impact on learning associated with the use of technology in the classroom, some groups report that use of laptops in the classroom can enhance academic achievements and satisfaction of students [8, 39]. The reason for these discrepancies is unclear, although it is possible that certain distractions may be more engaging (e.g., scrolling a Facebook feed), and, therefore, more distracting than others [48, 49], while other forms of distractions (e.g., an open laptop) might provide a subtle unconscious habitual distraction in the form of attraction towards certain frequently visited websites (e.g., Facebook) but do not cause a large deviation in attention [1]. Additionally, as many modern science, technology, engineering, and mathematics (STEM) collegiate classrooms are now incorporating active learning strategies into lecture-style classes to increase student comprehension and engagement [13, 38], these strategies may include electronic devices such as clickers [12]. Clickers can be used by instructors to ask students questions during class and allow students to respond immediately [12, 27] and have been shown to lead to an increase in student engagement [12, 40]. Clickers may be purchased devices for polling or polling can be done via web-based software (e.g., poll everywhere) that can allow students to use a personal electronic device, such as a cell phone. This increase in sanctioned cell phone use for polling purposes has led to increased off-task cell phone use [26]. In fact, a recent survey of US college students reported that on average, each day in class students used a digital device for non-academic purposes more than 11 times, spending 20% of class time on non-class related activities [26]. Thus, electronic devices may both help and distract from learning in the classroom.

While the literature on the impact of technology on cognition is growing, studies have long demonstrated the negative impact of various forms of multitasking on learning and memory. For example, studies of eighth graders in the Netherlands demonstrated that watching a Dutch-language soap opera while working on a task reduced accuracy and speed on both a paper-and-pencil task and a memorization task [30]. Similarly, background television affects even the youngest children during play; infants have shorter episodes of play and focused attention when background television is present [35]. Studies examining a variety of cognitive domains including episodic memory, attention, task-goal management and long-term memory generally demonstrate deficits in these cognitive tasks in subjects when multitasking (see [43] for a review). Episodic learning and memory (i.e., the learning of knowledge rather than practice) seems to be particularly suspectable to distractions [43]. However, some studies demonstrate that individuals that routinely engage in multitasking can demonstrate benefits on tests examining task-switching abilities [3]. The brains of children and young adults are still developing which provides further urgency to better understand the relationships between multitasking, memory and learning [34].

There is a similar mixed, albeit much smaller body of literature examining the impact of social media use on cognition and learning. Although some evidence suggests that social media may be beneficial for cognition, particularly memory functioning [21, 28, 44], other reports indicate social media use can result in unintended costs to memory [14]. For example, one study found that on days when social media use was high, individuals reported more memory failures [36]. However, this study utilized self-reported social media use which may not be as accurate as objective measures [20]. Another study found no effect of either texting or e-mail during class on performance on a multiple-choice assessment compared with a control group, revealing that only distraction by Facebook resulted in a significant performance decrement [49]. A separate study found that when students were distracted by social media during a visual and oral presentation, memory performance decreased only on examination questions based on information presented visually [25]. Collectively, these studies suggest performance deficits might depend on the type of distraction facing the student. These results also indicate social media might result in a distraction depending on the timing of its use; however, we are unaware of any studies examining this directly. The mechanisms underlying these effects remain largely unexplored, yet some data suggest that chronic social media multitasking is associated with a wider attentional scope/higher attentional impulsivity, which may allow goal-irrelevant information to compete with goal-relevant information [43]. Given the popularity and use of social media [29] and the increasing prevalence of electronic devices in the classroom [26], further investigation into the relationship between social media use and cognition is warranted.

In the current study, we examined how the timing of social media use (Instagram) impacted retention of presented material (i.e., cognitive short-term memory) in college students. Students were exposed to social media either during or immediately following oral presentation of new material. We hypothesized that exposure to social media during, but not immediately following, presentation of a new set of information would decrease a subject's recall accuracy when compared to subjects that were not exposed to social media. In addition to examining how the timing of social media use impacted memory, we also examined if the type or quantity of topics displayed in a subject's Instagram feed modulated memory. Our findings may have implications regarding the use of electronic devices and social media in the classroom.

2. Materials and methods

2.1. Participants

Participants were college undergraduates (n = 45; 36 women and 9 men) at a small liberal arts college in the US, aged 18–24 years who responded to in-class recruitment solicitations and were offered extra credit in one of their classes for participation. This particular demographic was chosen because they represent the single largest group of users interacting though social networks [29] and previous results have found conflicting reports regarding the impact of social networks on health in this population [6, 14, 21, 28]. All participants reported no chronic or acute illness, no regular medication regimen, and good health prior to study onset. All procedures were approved by the Regis University Institution Review Board.

2.2. Procedures

Subjects were asked to refrain from any physical exercise, meals, or any beverages at least 1 hour prior to testing time. Upon arrival at the lab, participants completed an informed consent form, were instructed of the testing procedures and randomly placed into one of three experimental groups (described below).

2.3. The logical memory test of the Wechsler memory scale IV

The Wechsler Memory Scale IV (WMS-IV) was administered as described previously [46]. The WMS-IV consists of seven subtests of which subjects completed only the Logical Memory Immediate Recall (LM I) subset. This part of the scale is optimized for testing immediate recall of information presented (common in a classroom setting) and is considered a useful and effective measure of episodic memory as it addresses three processes involved in memory: encoding, storage, and recall [23]. The LM I is a measure of auditory recognition memory designed to test participants ages 16 to 90 and has good test-retest reliability as well as inter-rater reliability [47]. The test consists of two stories of different lengths (65 words and 85 words), which were presented to subjects orally at a steady pace. Following listening to the first story, subjects answered a series of 15 true/false recognition questions on paper (Quiz 1). Once the first quiz was complete, subjects were read the second story and subsequently answered 15 additional true/false

recognition questions on paper (Quiz 2). Each correct question was awarded one point (15 points/quiz; 30 points total) and overall percent accuracy was calculated [2].

2.4. Experimental groups

Subjects were randomly assigned to one of three experimental groups (n = 15 subjects/group; male subjects dispersed evenly between the three groups). This sample size has been determined sufficient to report significant differences between groups [25]. The control group of subjects listened to the first story for one and a half minutes then sat quietly for an additional one and a half minutes before completing Quiz #1 (No Instagram). Using the same methods, subjects listened to the second story and completed Quiz #2. The second group of subjects listened to the first story while actively scrolling through their Instagram feed for one and a half minutes (Instagram During Story). These subjects were then instructed to sit quietly (not using Instagram) for an additional one and a half minutes after which point they completed Quiz #1. Using the same methods, subjects then listened to the secondary story and completed Quiz #2. The third group of subjects listened to the first story for one and a half minutes and then were instructed to actively scroll through their Instagram feed for one and half minutes (Instagram After Story) before completing Quiz #1. Using the same methods, subjects then listened to the second story and completed Quiz #2. Once subjects completed the second quiz they we asked to complete a short survey on their Instagram usage. The survey asked subjects to report the type of content displayed on their feed from a list of twelve topics derived from previous results ([29]; Table 1) and the total categories displayed in a subject's feed was calculated for each subject. Following completion of this survey, subjects were debriefed by the researchers about the goals of the study.

2.5. Statistical analysis

To assess the hypothesis that the type of activity (No Instagram, Instagram During Story, Instagram After Story) to which a subject was exposed to while listening to a story impacted their memory recall ability, we performed one-way analysis of variance (ANOVA). We then performed Fischer's paired least-significant difference (PLSD) post hoc analysis between each of the conditions. To examine subject Instagram use, separate unpaired t-tests (as only two groups had access to Instagram) and correlation analyses were conducted. Alpha was set at 0.05. Figures are shown as mean ± SEM or as individual data.

3. Results

3.1. Logical memory

Logical memory as assessed through the WMS-IV LM I between groups (No Instagram, Instagram During Story, Instagram After Story) using a one-way ANOVA revealed a significant difference, indicating that exposure to Instagram decreased memory recall (Fig. 1, $F(2,42) = 3.353$, $p = 0.04$). Post hoc analyses demonstrated that logical memory was lower in the group that used Instagram during the presentation of the story (71.55% ± 2.6) compared with the control group that did not use Instagram at any time (80.89% ± 2.1) ($p = 0.01$). A non-statistically significant trend was also observed between the group that used Instagram during the presentation of the story (71.55% ± 2.6) compared with the group that used Instagram after listening to the story (77.77% ± 2.9) ($p = 0.09$). A difference was not observed between the group that used Instagram after the presentation of the story (77.77% ± 2.9) compared with the control group that did not use Instagram at any time (80.89% ± 2.1) ($p = 0.44$). No differences were observed in memory recall between female and male participants ($p = 0.31$; data not shown). Collectively, these results suggest that social media use diminished memory recall ability when used during presentation of novel audio material.

Table 1
Appearance on Subjects' instagram feed.

Instagram topic	Frequency	Percent
Family/Friends	39	86.7%
Humor	35	77.8%
Influencer/Celebrity	28	62.2%
Animals	27	60.0%
Shopping/Advertisement	27	60.0%
Food	25	55.6%
Beauty	24	53.3%
Nature	24	53.3%
Travel	23	51.1%
Sports	20	44.4%
News	13	28.9%
Science/Technology	11	24.4%

3.2. Instagram use

In order to begin to examine how subjects were using Instagram, after completing the second quiz subjects were asked to complete a survey indicating the content of their Instagram browsing. The most popular Instagram topics browsed were Family/Friends, Humor, and Influencer/Celebrity, with the least popular topics related to Sports, News, and Science/Tech (Table 1). T-test indicated no differences in the amount of topics appearing in subjects' Instagram feed when comparing the two groups with access to Instagram (During and After the story) (Fig. 2, $F(1,28) = 1.856$, $p = 0.18$). Correlational analysis revealed no relationship between the logical memory recall ability and the number of topics appearing on an Instagram feed (Fig. 3; $r = -0.03$, $p = 0.75$). Taken together, these results suggest that neither the type of images nor the number of topics displayed on a subject's Instagram modulated the reduction in memory ability observed.

4. Discussion

The current study examined if using social media (Instagram) either during or immediately following presentation of new auditory material impacted retention of that material. Our results indicate that exposure to Instagram decreased memory recall (Fig. 1) when subjects were using Instagram while listening to a presentation. Subjects that were using Instagram during the presentation answered on average 71% of quiz questions correctly when assessed almost immediately following completion of the presentation, while subjects that did not use Instagram answered ~9% more answers correctly on average (80%; $p = 0.01$). In an academic setting this difference in performance is equal to a full letter grade (e.g., C- vs B-). Subjects that listened to the presentation without distraction and then used Instagram prior to taking the memory quiz performed slightly worse in memory recall (3%) than the group who did not use Instagram at all, although this small difference was not statistically significant.

The results from this study suggest that individuals may allocate attentional resources to their social media account rather than attending to presentation of new material which can result in a reduction in retention of new material. These results are consistent with a recent study where participants were instructed to either passively view a series of paintings, take photographs of the paintings, or use Snapchat (a photo-sharing-based social media platform) to document their experience of the paintings. Participants who used Snapchat demonstrated lower recall for the paintings than the other two groups [37]. The results of the current study, however, contrast with previous work that found student performance on questions from information presented orally was similar when students used social media to that of controls ([25], Elder et al., 2013). A possible explanation for these differences could be the variable amounts of time students were

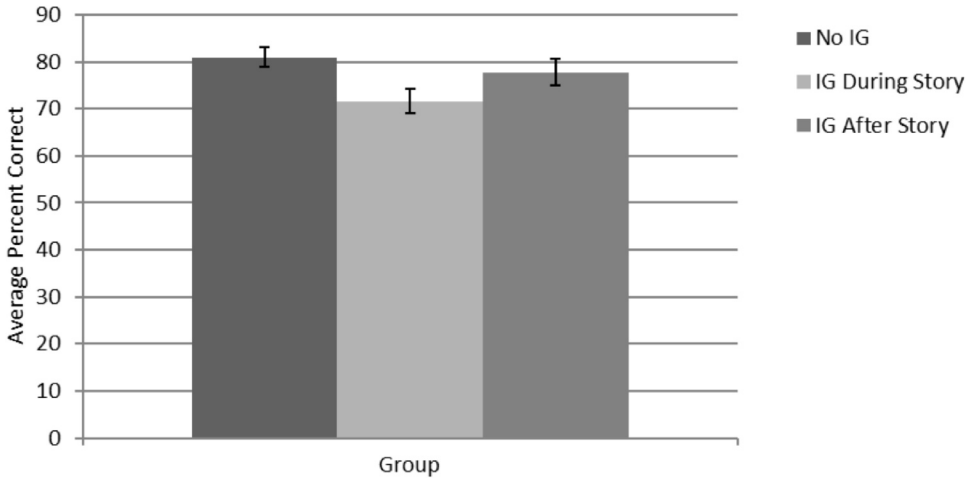

Fig. 1. Logical memory was assessed by calculating average percent correct answers to a recall quiz as part of the WMS-IV LM I. One-way ANOVA was used to compare differences in logical memory between groups (No Instagram (No IG), Instagram During Story (IG During Story), Instagram After Story (IG After Story)). Analyses indicated that exposure to Instagram decreased memory recall ($p = 0.04$). Fischer's paired least-significant difference (PLSD) analyses demonstrated that logical memory was lower in the group that used Instagram during the presentation of the story (71.55% ± 2.6) compared with the group that did not use Instagram at any time (80.89% ± 2.1) ($p = 0.01$). Alpha was set at 0.05. Data are shown with group means ± standard error of the mean.

distracted. In the study by Marone et al. [25], subjects used Facebook for 40% of the presentation while subjects in the current study scrolled through Instagram the entire length of the presentation. However, overall the literature does not support the idea of an inverse relationship between academic performance and time spent in distractive multitasking [10, 13, 16, 22]. Consistent with this body of work, in the current study the length of the distraction was controlled between groups (1.5 min), yet only the group that used Instagram during the presentation demonstrated a large performance deficit. Taken as a whole, these findings suggest that the timing of the distraction may be more important than total time distracted. In the classroom setting, even a brief distraction occurring at the time important material is presented could disrupt the learning process.

In addition to the timing of social media use, we also found no differences in the type or amount of topics appearing in subjects' Instagram feed when comparing the two groups with access to Instagram (During and After the story) (Fig. 2, $p = 0.18$). Moreover, a correlation was not found between logical memory recall ability and the number of topics appearing on an Instagram feed (Fig. 3; $r = -0.03$, $p = 0.75$). Taken together, these results suggest that neither the type of images nor the number of topics displayed on a subject's Instagram modulated the reduction in memory ability observed.

College students acknowledge that multitasking can be distracting and disruptive to learning ([41], Elder et al., 2013, [33]) yet many continue to use electronic devices in class [18, 33, 41]. Some authors have suggested that users are unable to stop themselves from using social media even if they are aware use might impact them negatively [1, 31]. Indeed, a recent study reported that social networking site addiction resulted in task distraction during a work shift in nurses [24]. However, as previously mentioned, some use of electronic devices (e.g., clickers) has been found to enhance the classroom experience [12] emphasizing that how individuals use electronic devices may also influence whether beneficial or detrimental effects emerge. Prior research demonstrates that more passive use (i.e., scrolling through feeds) is associated with more negative effects on well-being relative to more active social media use (i.e., chatting, posting comments) [11]. Overall, the ways in which social media is used likely will determine whether it is beneficial or harmful for memory. Future research should extend the results of the current study and examine whether short-term memory is modulated by social media site, motivation for use, and patterns of use.

5. Limitations

We did not control for scholastic aptitude or age in the current study and had a relatively small sample size. While the randomization of the groups likely reduced the chance that uneven distribution occurred, future studies should control for these variables and include a larger sample size. In addition, the relatively small number of male subjects in

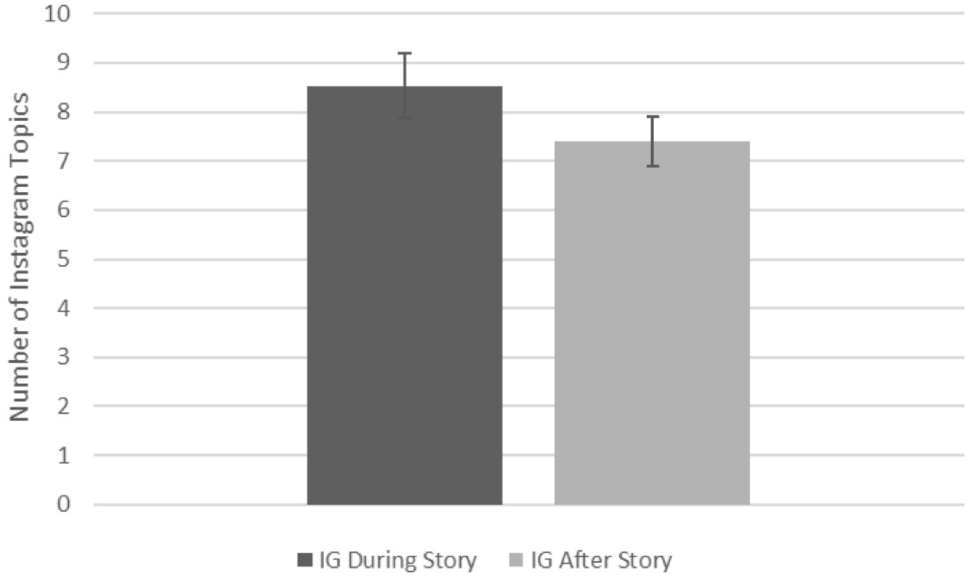

Fig. 2. Subjects reported the number of Instagram topics appearing in their Instagram feed. T-test was used to compare differences in number of Instagram topics between groups (Instagram During Story (IG During Story), Instagram After Story (IG After Story)). Analysis indicated no differences in the amount of topics appearing in subjects' Instagram feed when comparing the two groups with access to Instagram ($p = 0.18$). Alpha was set at 0.05. Data are shown with group means ± standard error of the mean.

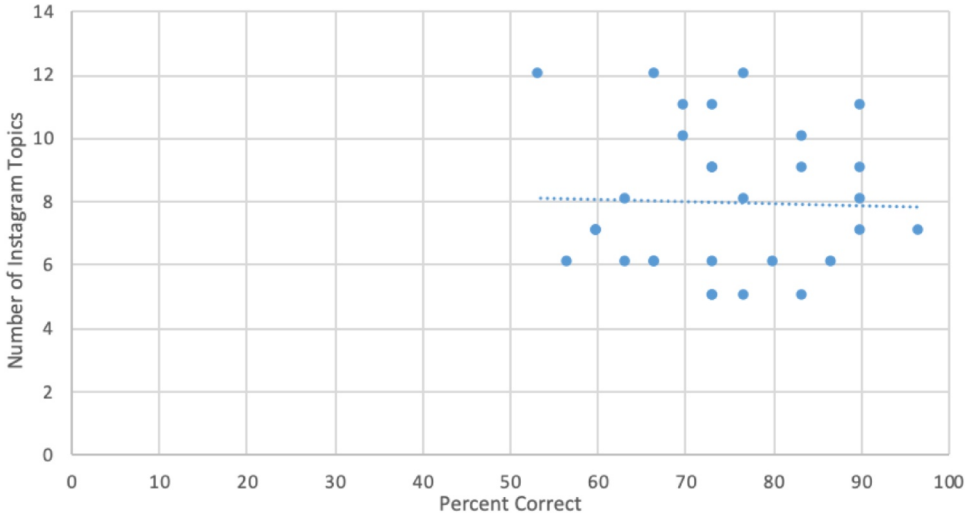

Fig. 3. The relationship between logical memory recall ability (average percent correct answers to a recall quiz) and the number of topics appearing on a subject's Instagram feed was examined. Correlational analysis revealed no relationship ($r = -0.03$; $p = 0.75$) between the logical memory recall ability and the number of topics appearing on an Instagram feed. Alpha was set at 0.05. Individual data are shown with a linear trend line calculated.

the study make it difficult to draw any conclusions about potential sex differences in episodic memory. Moreover, the small sample size prevented control of a variety of factors (e.g., stress levels, distractibility, attention) that can influence memory and should be examined in future work. Future studies should attempt to recruit a more balanced sample population in order to investigate potential differences based on sex. Finally, this study only examined the short-term effect of social media use on memory and future longitudinal research is needed to examine the long-term implications for memory functioning over different spans of time.

6. Conclusions

The results of the current study demonstrate that distraction by social media can result in a reduction in short-term memory recall when social media use occurs during the presentation of novel information. Furthermore, even short-term passive use of social media (scrolling through an Instagram feed) is sufficient to result in reductions in memory recall. Finally, it appears the timing of social media use, but not the time spent, the type of content viewed, nor the quantity of topics displayed, modulated the observed reductions in memory recall ability. The current study only examined one type of social media platform (Instagram) that involves looking at and scrolling through pictures/comments and our results might not be generalizable to other platforms. It remains unclear how the use of other social media platforms that require different levels of attention might influence learning and memory. These results have implications regarding the availability and/or use of electronic devices and social media in the classroom and are especially important given that more and more young people, whose brains are still developing [34], are engaging in media multitasking.

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