Multitasking Behaviors of Osteopathic Medical Students

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Context: To the authors' knowledge, few studies have investigated the relationship between electronic media multitasking by undergraduate and graduate students during lecture and their academic performance, and reports that have looked into this behavior have neglected to investigate factors that may influence students' multitasking during lecture.

Objective: To determine the extent to which medical students multitask during lecture; the types of multitasking; the frequency of multitasking and factors that influence frequency; and the correlation between multitasking and knowledge acquisition as assessed by a postlecture quiz.

Methods: A 1-page survey assessing students' multitasking behavior was administered to 125 second-year students at Edward Via College of Osteopathic Medicine and collected at the onset of a standard 50-minute lecture. On completion of the 50-minute lecture, an unannounced 10-question multiple-choice quiz was given to assess knowledge acquisition during those lectures. On a separate date, after a standard 50-minute lecture, a second quiz was administered.

Results: The 1-page survey revealed that 98% of students check e-mail, 81% use social media, and 74% study for another class. Students spent the most time studying for another class (23 minutes) followed by using social media (13 minutes) and checking e-mail (7 minutes). The most influential factors behind multitasking were examination schedule (91%), lecturer (90%), and the number of lectures in the day (65%). The mean score for quiz 1 (the day after an examination) was 75%, and the mean score for quiz 2 (the day before an examination) was 60%.

Conclusion: Multitasking during lecture is prominent among medical students, and examination schedule is the most influential factor. Although a robust drop in mean score on a lecture-based, unannounced quiz was identified 1 day before a scheduled examination, the effect from multitasking on this process remains unclear.

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The generation born between approximately 1980 and 2000 was brought up during a time of rapidly advancing computer technology and electronic media. Currently referred to as *Millennials*, this generation is also known as *generation Y*, *the wired generation*, *the multitasking generation* (*GenM*), and *generation next*.[1-8] The constantly evolving technology has enabled us to have a world of information in the palm of our hands. It has provided many ways to communicate, using e-mail, chatting or instant messaging, texting, and social networking through the use of cell phones and other mobile

devices and computers.[7-9] It is estimated that up to 75% of Millennials are connected through Facebook or other social networking websites worldwide.[10] Technology has also allowed us to share and access information quickly as well as provide a means to electronically multitask, with the goal of productivity in work, education, communication, and personal life.[4]

Studies have defined multitasking as a person's ability to simultaneously perform 2 or more functions or to quickly focus attention back and forth between 2 or more tasks (eg, listening to music while running, or texting in a movie theater) through a cognitive process called *context switching*.[4,8,11-13] The Pew Research Center's Internet and American Life Project reported that 82% of students in middle school spent time on computers and at least 8.5 hours per day multitasking. Most of their tasks included instant messaging, computer games, and browsing websites.[8,14] Results of a survey showed that more than half of high school students multitask "most of the time," and approximately 25% watched television or chatted with friends while doing homework.[15] The frequent use of smartphones and laptops by anesthetists for professional and personal use in operative rooms has also been investigated.[16] It seems that multitasking has become a way of life for Millennials, and the extent of multitasking for this generation will either stay level or increase as technology advances.

To accommodate and improve the learning of Millennials, teaching methods in classrooms have been revolutionized from traditional white-board teaching to media-enhanced teaching, such as the use of PowerPoint-based methods.[4,8] Digital screen teaching has encouraged the use of laptops in the classroom, which has offered students more ways to multitask in a learning environment.[4,17] Fried[17] reported that undergraduate students spend a large portion of their time multitasking on laptops while in class. Recent studies show that most students multitask in the classroom with nonacademic purposes.[4,7,18] Furthermore, a study determined that most business students used their cell phones for texting and accessing social networking sites, such as Facebook and YouTube, during lecture and while studying outside class.[18] Extensive multitasking by means of mobile devices and laptop computers during lecture is becoming a serious concern because multitasking has been reported to diminish students' learning.[4,5,7-9,11,13,19-21]

One report[22] found that the brain can process only 1 task at a time, and when switching between tasks, the brain produces an "illusion" that 2 tasks are being processed at the same time. The authors concluded that multitasking negatively affects declarative learning, which is associated with storing and retrieving processes from the prefrontal cortex of the brain, so that the brain has reduced capability to recall previous tasks.[22] In functional magnetic resonance imaging–based studies, neuroscientists have shown that multitasking or a "dual-task condition" is considered a distraction, decreasing the brain's ability to efficiently store information.[4,22] In other words, each task performed gets processed differently, such that the brain has to internally recalibrate or reset its attention to each task, resulting in slower and less precise execution in a repeated situation.[20] Although multitasking may allow for using time efficiently, it involves frequent attention shifts that progressively sacrifice the needed constant focus during cognitive functions.[4,5,7,13] Some researchers have claimed that multitasking inversely affects "working memory," which refers to the memory that actively uses either recently stored information or data from long-term memory.[13] Ophir et al[19] suggested that frequent electronic multitasking leads to differences in informational processing in the brain and difficulty in straining out extraneous stimuli compared with infrequent electronic media multitasking.[19] Students should focus on 1 task while engaged in learning to better retain and recall the acquired knowledge in the future.[5] In addition, some have argued that "multitasking depletes direct attention and leads to mental fatigue."[23]

Ellis et al[4] conducted a study in which half of 62 business students were allowed to text during lecture, and the other half were to focus solely on the lecture.[4] A quiz was

administered at the conclusion of the lecture, and the results showed that the multitasker group scored statistically significantly lower than the nonmultitaskers. An investigation of the effects of electronic media multitasking while in class, studying, or doing homework on academic performance of first-year undergraduate students showed that on average, for every hour of electronic media use by the students, their grade point average (GPA) was reduced between 0.05 and 0.07 points.[7] Furthermore, the use of social networking, cellular phones, electronic gaming, and television and movie exposure were negatively correlated to GPA. Collectively, studies[4,7,8,14,17,18] have shown that electronic media multitasking during lecture, studying, or doing homework leads to a decrease in academic performance.

Many studies[4,5,7-9,11,13,19,21] have been able to show the brain's adaptation and tapered response to multitasking. Some studies[4,7,8,14,17,18] have investigated the inverse relationship between electronic media multitasking by undergraduate students during lecture and their academic performance. These studies had not considered the factors that may have influenced the students to multitask with electronic media during lecture. In addition, electronic media multitasking by graduate students during lecture has not been investigated, to our knowledge.

The primary objective of the present study was to determine whether or not medical students multitask during lecture, the types and frequency of multitasking, and the factors that influence these behaviors. The secondary objective was to determine whether an association between multitasking and knowledge acquisition exists.

Methods

The present study was approved by the institutional review board at the Edward Via College of Osteopathic Medicine (VCOM–Virginia Campus, Blacksburg) and VCOM student services. Participants were second-year osteopathic medical students, and the class demographics were obtained from VCOM's website (http://www.vcom.edu/admissions/profile-2015-carolinas.html). The mean age of the class was 24 years, and the male-female ratio was 1:1. Approximately 7% of the class were underrepresented minorities, and 14% were "multicultural." Participation in the study was voluntary.

According to the institutional review board's guidelines, a consent form and coversheet were developed explaining the purpose of the study and the group conducting the investigation. The students were assured that study personnel would not have access to their GPAs and that anonymity would be maintained. Students were asked to come up with a pseudonym to use on all study materials. They gave informed consent by submitting these questionnaires.

We constructed a survey consisting of 2 closed-ended items in which students were asked (1) to identify their multitasking activities, if any, and the time spent multitasking during a 50-minute lecture and (2) to identify the factors influencing their multitasking behaviors.

The day after a scheduled examination (a scheduled examination meant that according to the VCOM curriculum, a VCOM scheduled/announced examination was to be given on this day), we administered an unanticipated 1-page survey to 125 students before a 50-minute clinical lecture. We remained outside the classroom so students would not feel coerced to participate. About 10 minutes were given to complete the survey, after which time, student investigators collected all surveys, and the lecturer returned to carry out the 50-minute lecture.

On the same day that the survey was given and near the conclusion of the lecture, an unannounced optional quiz (quiz 1) composed of 10-multiple-choice questions pertaining to the 50-minute lecture was administered by the lecturer. Students were asked to use the same pseudonym from their survey or to create one if they previously did not participate. Two weeks after the survey and quiz 1, quiz 2 was administered, this time 1 day before a scheduled examination. Again, students were asked to use the same pseudonym from their survey or to create a new one if they did not complete the survey.

Quiz 1 was given 1 day after a scheduled examination and quiz 2 was given 1 day before a scheduled examination. The pseudonyms were cross-matched, and only the data from students who completed both quizzes were used to analyze the mean quiz scores, the SDs, and the 95% CIs.

Results

Of the 160 second-year VCOM medical students in attendance for lecture, 125 filled out and submitted the survey, giving a raw response rate of 78%.

Of the survey respondents, 123 (98%) check e-mail, 102 (81%) visit social media, 93 (74%) study for another course, 83 (66%) text, 63 (50%) read other material online or on paper, 39 (31%) shop online, 32 (25%) read or watch sports online, 16 (11%) play games online, and 14 (13%) engage in other Internet activities, such as surfing Netflix, Pinterest, and YouTube; attending to other personal activities; and daydreaming, all within a typical 50-minute lecture (*Figure 1*).

In a typical 50-minute lecture, students reported to spend 23 minutes studying for another class; 13 minutes reading other materials and using social media websites online; 8 minutes shopping; 7 minutes playing games online, texting, and checking e-mail; and 21 minutes doing other personal activities (*Figure 2*).

The survey also showed that influential factors behind multitasking during a lecture were back-to-back examinations every week (114 [91%]), lecturer (112 [90%]), too many lectures per day (82 [65%]), lack of interest in the material presented (62 [48%]), lack of sleep (46 [37%]), and other personal activities (19 [16%]) (*Figure 3*).

The first scheduled examination was taken by 97 students and the second scheduled examination was taken by 72 students. Sixty-five of the students who completed the survey completed both quizzes. The quiz 1 mean (SD) was 75.3% (3.8%) , and the quiz 2 mean (SD) was 60.4% (5.0%).

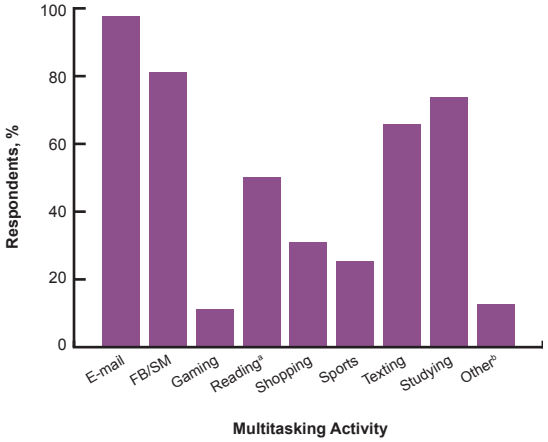

Figure 1.
Percentage of respondents (second-year osteopathic medical students) who reported multitasking with electronic media during lecture (N=160). [a] "Reading other material electronically or non-electronically (hard copy or printed materials)." [b] Two "other" activity spots were available to respondents in the survey form. *Abbreviation:* FB/SM, Facebook or other social media.

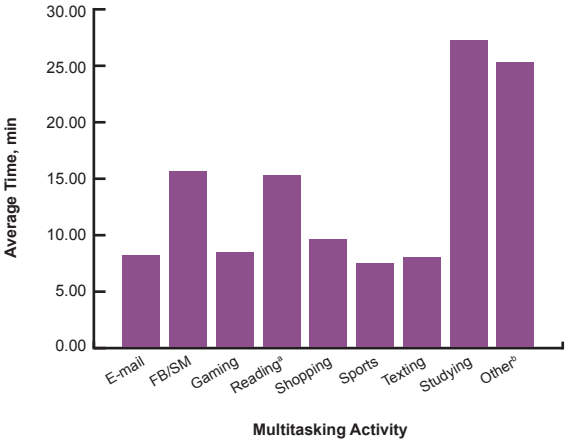

Figure 2.
Average time spent multitasking during lecture. [a] "Reading other material electronically or non-electronically (hard copy or printed materials)." [b] Two "other" activity spots were available to respondents in the survey form. *Abbreviation:* FB/SM, Facebook or other social media.

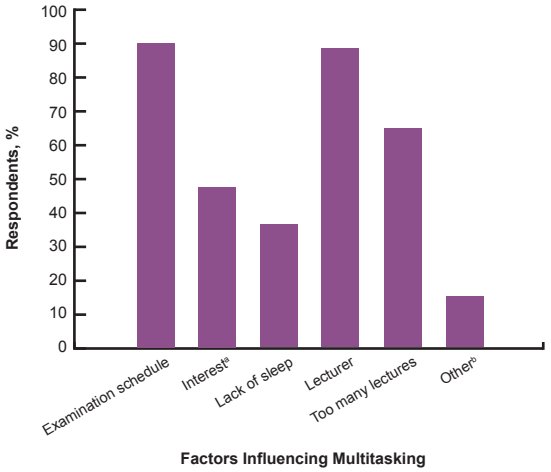

Figure 3.
Percentage of respondents (second-year osteopathic medical students) who cited reasons for multitasking during lecture. [a] "Interest in the discipline (eg, anatomy, pharmacology, etc)." [b] Three "other" activity spots were available to respondents in the survey form.
Abbreviation: FB/SM, Facebook or other social media.

Discussion

The present study was designed to obtain information about multitasking behaviors among students enrolled in a US osteopathic medical school. To our knowledge, the present study is the first investigation into multitasking with electronic media by this population. Students at VCOM are required to attend a minimum of 85% of lectures; the translation of our findings to medical schools with different policies is unclear. A high raw response rate provides more accurate statistical inferences toward the US medical student population. However, the attendance policy likely skewed the raw response rate, and any conclusions based on this study's results would therefore be inaccurate.

The survey was constructed and internally validated to ensure that the answers appropriately addressed the 2 questions. Although the mean score had dropped from quiz 1 to quiz 2, there was a form of sampling bias present, known as nonprobability sampling methods, and the data obtained cannot provide support for or against other work. Also, the data were collected at a US osteopathic medical school; the small sample size (N = 125) and restricted group (second-year VCOM students) may not be reflective of the US medical student population. Future investigations on multitasking behaviors and influences at other US medical schools would append the presented data, augmenting the statistical power.

Conclusion

The most commonly reported factors influencing multitasking behaviors were identified to be an upcoming examination and the number of lectures in a row. The effect of multitasking during lecture on knowledge acquisition has been ill-defined. Although a robust drop in mean quiz score was identified in the current study, when collected 1 day before an examination, the effect of increased multitasking on knowledge acquisition and retention remains unclear.

Author Contributions

Student Doctors Shah, Mullens, and Van Duyn and Dr Januchowski provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; drafted the article or revised it critically for important intellectual content; and gave final approval of the version of the article to be published.

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