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Laptop multitasking hinders classroom learning for both users and nearby peers

Faria Sana [a], Tina Weston [b,c], Nicholas J. Cepeda [b,c,*]

[a] McMaster University, Department of Psychology, Neuroscience, & Behaviour, 1280 Main Street West, Hamilton, ON L8S 4K1, Canada
[b] York University, Department of Psychology, 4700 Keele Street, Toronto, ON M3J 1P3, Canada
[c] York University, LaMarsh Centre for Child and Youth Research, 4700 Keele Street, Toronto, ON M3J 1P3, Canada

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A B S T R A C T

Laptops are commonplace in university classrooms. In light of cognitive psychology theory on costs associated with multitasking, we examined the effects of in-class laptop use on student learning in a simulated classroom. We found that participants who multitasked on a laptop during a lecture scored lower on a test compared to those who did not multitask, and participants who were in direct view of a multitasking peer scored lower on a test compared to those who were not. The results demonstrate that multitasking on a laptop poses a significant distraction to both users and fellow students and can be detrimental to comprehension of lecture content.

1. Introduction

Multitasking is ingrained in our daily lives. As you read this article, you may also be attending to a text message, sipping coffee, or writing out a list of to-dos. Such a lifestyle is intended to increase efficiency; however, there are limitations to how well multiple tasks can be carried out concurrently (Posner, 1982). Multitasking places considerable demands on cognitive resources, which, in turn, degrades overall performance, as well as performance on each task in isolation (Broadbent, 1958). The issue of multitasking and its consequences has become a growing concern in education, as students are more commonly found engaged with their laptops or smartphones during class time. The current study investigated the effect of laptop multitasking on both users and nearby peers in a classroom setting.

There is a host of theoretical and experimental research on divided attention and dual-task interference, terms that we consider homologous to multitasking and therefore relevant to the current discussion. Research suggests that we have limited resources available to attend to, process, encode, and store information for later retrieval (Posner, 1982). When focused on a single primary task, our attentional resources are well directed and uninterrupted, and information is adequately processed, encoded, and stored (Naveh-Benjamin, Craik, Perretta, & Tonev, 2000). When we add a secondary task, attention must be divided, and processing of incoming information becomes fragmented. As a result, encoding is disrupted, and this reduces the quantity and quality of information that is stored (Pashler, 1994). When we eventually retrieve information that was processed without interruptions, as a primary task, we are likely to experience minimal errors. When we retrieve information that was processed via multitasking or with significant interruptions from a secondary task, we are more likely to experience some form of performance decrement (Wickens & Hollands, 2000).

Indeed, managing two or more tasks at one time requires a great deal of attention. Attentional resources are not infinite (Konig, Buhner, & Murling, 2005; Pashler, 1994). When the level of available attentional resources is less than what is required to complete two simultaneous tasks, performance decrements are experienced since both tasks are competing for the same limited resources. This is especially true if both tasks are competing for resources within the same sensory modality (Navon & Gopher, 1979; Wickens, 2002; Wickens & Hollands, 2000). Limits to attentional resources means the quality (accuracy) and efficiency (reaction time) at which multiple tasks are processed will be compromised (Rubinstein, Meyer, & Evans, 2001). Numerous experimental studies have shown performance decrements under conditions of multitasking or divided attention (e.g., Broadbent, 1958; Tulving & Thomson, 1973).

* Corresponding author. York University, LaMarsh Centre for Child and Youth Research, 4700 Keele Street, Toronto, ON M3J 1P3, Canada. Tel.: +1 416 736 2100x33266; fax: 1 416 736 5814.
E-mail addresses: sanaf@mcmaster.ca (F. Sana), westont@yorku.ca (T. Weston), ncepeda@yorku.ca (N.J. Cepeda).

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Theoretical and empirical findings on multitasking are especially significant when considered in the context of student learning. In classroom environments, students tend to switch back and forth between academic and non-academic tasks (Fried, 2008). This behavior poses concerns for learning. The presumed primary tasks in many university classes are to listen to a lecture, consolidate information spoken by the instructor and presented on information slides, take notes, and ask or respond to questions. On their own, these activities require effort. If a secondary task is introduced, particularly one that is irrelevant to the learning context, attention must shift back and forth between primary and secondary tasks, thereby taxing attentional resources. This multitasking can result in weaker encoding of primary information into long-term memory (Bailey & Konstan, 2006; Ophira, Nass, & Wagner, 2009).

The personal computer provides a compelling source of classroom distraction and has become commonplace on university campuses. Survey data estimates that 99% of incoming freshmen own a laptop (University of Virginia, 2009) and about 65% of students bring their laptop to class (Fried, 2008). Research on educational laptop use addresses both the pros and cons of using this technology in the classroom. On the one hand, laptops have been shown to assist learning through active approaches to teaching (Finn & Inman, 2004) and promotion of academic success (Lindorth & Bergquist, 2010; Weaver & Nilson, 2005). When used for academic purposes such as taking notes and using software programs (Driver, 2002), accessing supplemental resources and web-based activities (Debevec, Shih, & Kashyap, 2006), and viewing PowerPoint slides (McVay, Snyder, & Graetz, 2005), in-class laptop use can increase satisfaction, motivation, and engagement among students (Fried, 2008; Hyden, 2005; Weaver & Nilson, 2005). On the other hand, studies suggest that students who use laptops in class report low satisfaction with their education, are more likely to multitask in class, and are more distracted (Wurst, Smarkola, & Gaffney, 2008). Student self-reports and classroom observations suggest that laptops are being used for non-academic purposes, such as instant messaging and playing games (Barak, Lipson, & Lerman, 2006; Driver, 2002), checking email and watching movies (Finn & Inman, 2004), and browsing the Internet (Bugeja, 2007). Access to online entertainment makes it increasingly difficult for instructors to be “more interesting than YouTube” (Associated Press, 2010, p. 10), especially if students aren’t intrinsically motivated by the subject materials. Moreover, time spent multitasking with these activities is significant; data from one study estimates that students multitask for approximately 42% of class time (Kraushaar & Novak, 2010).

Importantly, distractions from in-class multitasking correlate with decrements in learning. Students who multitask on laptops during class time have impaired comprehension of course material and poorer overall course performance (Barak et al., 2006; Hembrooke & Gay, 2003; Kraushaar & Novak, 2010). In a recent study, Wood et al. (2012) measured the detriments of technology-based multitasking in a classroom setting. This study is one of few in the field that employed an experimental design (much of the literature is self-report). Students were assigned either to a single multitasking condition (using Facebook, MSN, email, or cell phone texting), a control group (paper and pencil notes-only or word processing notes-only), or a free-use-of-technology condition (where participants could choose to multitask or not multitask on their laptop as much as they wished). Over the course of three class lectures, participants’ comprehension of the material was assessed via quizzes. In general, paper and pencil control participants outperformed multitasking participants on the quiz assessments (particularly MSN and Facebook users). However, as the authors admit, there were limitations to the methodology of this study. Most noteworthy was that 43% of participants self-reported that they did not adhere to their assigned instructions across all three lectures. For example, a participant assigned to the Facebook multitasking condition may have multitasked on Facebook and on MSN (i.e., two forms of multitasking when they were instructed only to use one form), or chosen not to multitask on Facebook at all. Therefore, the experimental manipulation was not successful, calling into question the validity of the quiz data. Although the authors corrected for this limitation in post-hoc analyses, the results should be interpreted with caution as they are reliant on self-report and the sample size of each group was significantly reduced. Wood et al.’s findings are relevant but restricted in terms of the pedagogical recommendations that can be offered. One goal of the present study was to replicate the findings of Wood et al. using a more controlled design and more stringent fidelity measures.

Disrupting one’s own learning is an individual choice; harming the learning of other students in the class is disrespectful. Laptop distractions due to movement of images and laptop screen lighting (Melerdiercks, 2005) and multitasking activities (Crook & Barrowcliff, 2001) may cause involuntary shifts of attention among students in close proximity to laptop users (Barak et al., 2006; Chun & Wolfe, 2001; Finn & Inman, 2004). These studies suggest that students are annoyed and distracted by laptop use. However, to our knowledge, no studies have directly measured the effects of distraction caused by laptop users on surrounding peers’ learning. Therefore, a second goal of the present study was to examine the indirect effects of laptop multitasking on student learning.

2. Experiment 1

In Experiment 1, we investigated whether multitasking on a laptop would hinder learning as measured by performance on a comprehension test. All participants were asked to attend to a university-style lecture and take notes using their laptops as a primary task. Half the participants, by random assignment, received additional instructions to complete a series of non-lecture-related online tasks at any convenient point during the lecture. These tasks were considered secondary and were meant to mimic typical student web browsing during class in terms of both quality and quantity. We hypothesized that participants who multitasked while attending to the lecture would have lower comprehension scores compared to participants who did not multitask.

2.1. Method

2.1.1. Participants

Forty-four undergraduate students from a large comprehensive university in a large Canadian city participated in the study (25 females; M age $= 18.9$ years, $SD = 2.0$). All participants were enrolled in an Introductory Psychology course and received course credit for participating in the experiment. Participants represented a variety of undergraduate disciplines (i.e., not only psychology). They were recruited using an online portal designed for psychology research, which explained that the study involved listening to a class lecture and filling out a few questionnaires. Only students who could bring a personal laptop to the experiment were invited to participate. Forty participants were included in the final data analysis, which included two experimental conditions: multitasking ($n = 20$) and no multitasking ($n = 20$). Of the four participants removed from the analysis, two had previous knowledge of the lecture content (as measured by a screening questionnaire), one performed below chance on the comprehension test, and one failed to follow instructions. The former two participants were removed from the no multitasking condition, and the latter two participants were removed from the multitasking condition.