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Lydia J. Burak

Bridgewater State University, lburak@bridgew.edu

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Multitasking in the University Classroom

Lydia Burak

Bridgewater State University
Bridgewater, Massachusetts, USA
LBurak@bridgew.edu

Abstract

Although research evidence indicates that multitasking results in poorer learning and poorer performance, many students engage with text messaging, Facebook, internet searching, e-mailing, and instant messaging, while sitting in university classrooms. Research also suggests that multitasking may be related to risk behaviors. This study's purpose was to describe the multitasking behaviors occurring in university classrooms and to determine relationships between multitasking and risk behaviors. Surveys assessing multitasking, grades, and risk behaviors were completed by 774 students. Results show that the majority of students engage in classroom multitasking, which is significantly related to lower GPA and an increase in risk behaviors.

Keywords: Multitasking, GPA, classroom behavior, risk behaviors

Introduction

Despite evidence that multitasking is non-facilitative and inefficient, it is nonetheless widespread and multitaskers take pride in this putative skill, considering it a favorable quality to list on resumes and job applications (Rosen, 2008). Bannister and Remenyi (2009) remark that it is commonly assumed that multitasking is a more effective way of working than the traditional single task approach.

Commonly understood as engaging in two or more things at the same time, a more accurate definition of multitasking is the performance of multiple tasks sequentially and in quick succession (Dzubak, 2008). Although it is clearly possible to engage in two behaviors simultaneously (eating and listening to music; walking and carrying on a conversation), only one task can have the full attention of the conscious mind at any point in time (Pashler, 2000; Bannister & Remenyi, 2009). The subconscious mind, however, can simultaneously do those things that have been so ingrained by repetition and training that they have become automated or rote.

Multitaskers switch from one task to another in rapid succession and engage a part of the frontal cortex called the Brodmann area. Functional magnetic resonance imaging studies have found a sort of traffic jam that occurs when that part of the cortex is faced with several stimuli at once (Dux, Ivanoff, Asplund, & Marois, 2006; Marois, Larson, Chum, & Shima, 2005). This bottleneck results in time lost as the brain attempts to determine which task to perform or which stimulus to attend to, thus resulting in less efficiency. Rubenstein, Meyer, and Evans (2001) found that the time lost when the brain switches attention increases with the complexity and the unfamiliarity of the tasks. Ophira, Nass, and Wagner's (2009) studies with university students showed that the juggling between tasks leads to poorer performance as well as the increase in time needed to complete tasks.

Learning and Multitasking

The rapid task-switching that multitaskers engage in appears to result in poorer learning. Just et al.'s (2001) functional magnetic resonance imaging (fMRI) study scanned participants' brains while they were involved in complex drawing and sentence comprehension tasks and assessed the activation of brain regions. When the participants attempted to perform the tasks concurrently, the activation in the cortical systems decreased in relation to the activation when the tasks were performed separately. Poldrack and Foerde's (2007) fMRI studies showed that learning while attempting to multitask changes the brain's learning processes and that people attempting to learn something new while being distracted by something else had a harder time learning. Nevertheless, many of today's university students appear to be constantly distracted and simultaneously engaging with text messaging, Twittering, checking Facebook, searching the internet, e-mailing, listening to music, instant-messaging, and doing school work.

The effects of multitasking on academic performance have been studied and results appear to indicate that multitasking is associated with poorer performance. Ellis, Daniels, and Jauregui (2010) conducted an experiment with undergraduate business students wherein half of the students were randomly assigned to a condition wherein they could text message during a lecture, and the other half were instructed to turn off their phones during the same lecture. After the lecture all of the students completed the same quiz based on the lecture. The non-texting students scored significantly higher ($p < .001$) on the quiz than did the texting students (regardless of overall GPA).

Kraushaar and Novak (2010) examined undergraduate university student laptop use during a 15 week management information systems class for which there was a laptop requirement. The researchers developed a survey wherein questions asked if students used their laptops for note taking, e-mail, instant messaging, surfing the web, or playing games during the class lectures. In addition to the self-reported surveys, data were collected on approximately half of the participants (who volunteered and consented to install the software after being apprised of the purpose of the study) via Activity Monitor™ spyware. The spyware recorded the windows/ page names for each software application run on the laptops. Kraushaar and Novak classified the application windows as productive or distractive. Productive windows were those applications related to the course materials and course-related websites. Distractive windows were non course related and included games, pictures, e-mail, instant messaging, and non course related surfing. The researchers determined the number of active windows generated during the lectures and measured the frequency of multitasking behavior. They found that students generated more distractive windows per lecture than productive windows, and that students with the larger amounts of distractive multitasking had significantly lower scores on homework, projects, quizzes, final exams, and final course averages than did the students who engaged in less distractive multitasking. Kraushaar and Novak also found that students understated their own multitasking behaviors. Approximately 87% of the students reported on the surveys that they used e-mail during class lectures, while 94% were actually recorded using e-mail. And 25% reported instant messaging during class, while 61% were observed instant messaging via the spyware.

In addition to affecting grades, the time taken to complete academic tasks may also be influenced by multitasking. An experiment that involved instant messaging (IM) while

reading was conducted by Bowman, Levine, Waite, and Gendron (2010). Undergraduate university students enrolled in general psychology classes were assigned to read a 3828 word passage on personality disorders on a computer monitor. The students were randomly assigned to three groups: one group engaged in instant messaging before reading the passage, one group engaged in instant messaging while reading the passage, and the third group read the passage and did not engage in any instant messaging. The students who engaged in instant messaging while reading took between 22 and 59% longer to read the passage than did the students who IM'd before reading or who did not IM at all – even after subtracting the time spent instant messaging.

Kirschner and Karpinski's (2010) exploratory study of university students' use of the social networking site Facebook and academic performance found that Facebook users reported lower GPAs than non Facebook users and also reported spending less time studying. Kirschner and Karpinski posit that they assume that student Facebook use is concurrent with studying and other learning activities and that the attempts to multitask can have negative impacts on effectiveness and efficiency of cognitive processes.

Media Multitasking and Risk Behaviors

A great deal of the multitasking in which young people engage involves electronic devices and media (computers, cell phones, game stations, televisions). Studies of college and high school students found that the majority of them engage in multiple media use at the same time (Baron, 2008; Foehr, 2006). Junco and Cotton (2011) studied nearly 3000 instant-message- using college students from four institutions; 97% reported that they engaged in other computer uses while instant messaging and 93% reported watching television, talking on the phone, or engaging in other activities while instant messaging on their computers. In addition to compromising learning, media multitasking may also be related to high risk behaviors. In her study of 2032 school aged youth, Foehr (2006) found that individuals who were more likely to be media multitaskers were also more likely to engage in risky behaviors. Carson, Pickett and Janssen's (2011) study of more than 8000 middle and high school youth found that those with the highest computer and television use had the highest incidence of risk behaviors including smoking, drunkenness, marijuana and other drug use, non-use of seatbelts and non-use of condoms. Although Carson, Pickett and Janssen did not specifically examine simultaneous use of the computers, TV, and video games, the nearly 75 hours of weekly use recorded by some of the participants is consistent with Roberts and Foehr's (2008) calculation that media multitasking results in approximately eight and one half hours of media exposure daily. Roberts and Foehr also indicate that exposure to media is positively related to risk-taking behaviors and is negatively related to academic performance.

Inasmuch as learning may be affected, it is important to examine the extent of multitasking in today's college and university classrooms and to determine if said multitasking is associated with negative outcomes. Concerns regarding risk behaviors and media multitasking merit the examination of possible associations among risk behaviors and classroom multitasking behaviors. The purpose of this study, therefore, is to describe the extent of multitasking that occurs in university classrooms, and to determine relationships among classroom multitasking, grades, and risk behaviors.

Method

Participants and Procedures

Study participants were students enrolled at a mid-sized public university in the northeast US. After approval was obtained from the Institutional Review Board, surveys were administered by research assistants in high traffic, high volume areas of the campus, including dining halls, cafeterias and coffee shops, computer labs, building lobbies, the library, the fitness center, and the campus center. Participants were approached by the assistants, and asked if they would be willing to complete a survey. They were informed of the purpose of the study and were told that the study was anonymous and that there would be no way to identify study participants; they were also assured that participation was totally voluntary. Those students who agreed to participate were given letters of informed consent and surveys. After completing the surveys, the students placed them in envelopes and returned them to the research assistants.

Instrumentation

A survey instrument was designed to assess multitasking behaviors, risk behaviors, demographics, and personality characteristics. In order to develop items that addressed multitasking, 30 students were asked to identify the non-class-related activities in which they engaged while they were in class. Because of the proliferation of online courses and the increasing number of students taking online courses, the students who had taken online courses were also asked to identify the activities in which they engaged while they were on their computers working on online classes. The 30 students were selected to approximate the study population; they represented 10 different academic majors within all four colleges of the university. They represented all the classes, from freshmen to graduate students; and they also included non-traditional older students as well as the traditional college-aged students. They included some students who had taken online courses as well as those who had not. Their lists were content analyzed, similar items were combined, and the resulting information was used to formulate the questionnaire's multitasking items. Twenty one different activities were identified by the focus group participants. Those activities that were identified most frequently by the most number of individuals were included in the survey. The nine most commonly identified activities were: using Facebook, text messaging, instant messaging, e-mailing, working on other classes, talking on the telephone, listening to music, eating, and drinking. The survey items asked respondents if they engaged in each of the activities while in their traditional classes, and the frequency of their engagement (1= never to 5= very frequently). The survey items also asked if the students engaged in the activities while on their computers engaged in online classes, as well as the frequency of engagement. A multitasking score was calculated based on the number of multitasking activities engaged in as well as the frequency of engagement.

The risk behavior items addressed risk behaviors identified by the National College Health Risk Behavior Survey (Centers for Disease Control, 1997). They included 19 items that addressed alcohol, tobacco, and other drug use; safety behaviors, such as seatbelt and helmet use, riding with drunk drivers, driving after drinking; sexual behaviors; suicide attempts; physical fighting; fruit and vegetable consumption; and exercise behavior. The majority of these items were open response, e.g. "In the past 30 days, how many days did you smoke marijuana?" Demographic items included age, gender, race/ethnicity, class, major, GPA, full time-part time status, and number of online classes taken.

Results

Characteristics of the Participants

Study participants included 774 students. They included 236 first year students, 157 sophomores, 177 juniors, 157 seniors, 38 graduate students, and 13 who did not identify their class. Their age range was 18 – 55, with a mean age of 20.75 years; females comprised 67.1% of the study population. The majority of the population was white, non-Hispanic (90.6%). The students represented all four colleges of the university (Humanities and Social Sciences, Education and Allied Studies, Science and Mathematics, Business); most students (94.5%) were full time students. Although the sample was a convenience sample, it was quite representative of the student population. The sample represents the same percentage of males and females, and whites and students of color as does the university population. All grade levels and all four colleges of the university were represented in very close proportion to the overall student enrollment in each of the grade levels and colleges.

Multitasking behaviors

Multitasking in the classroom was extremely prevalent among the study population; only 9 individuals reported no multitasking behaviors. When eating and drinking were removed from the analysis (because eating and drinking don't require focused attention and don't compete with other activities for the attention of the conscious mind), there were 44 individuals (5.6%) who reported no multitasking activities in the classroom. Although many of the activities were reportedly done infrequently, others were done with much higher frequency. Table 1 indicates the numbers of students engaging in multitasking behaviors frequently or very frequently.

Table 1. Students Frequently or Very Frequently Engaging in Multitasking Behaviors While in the Classroom; n = 774

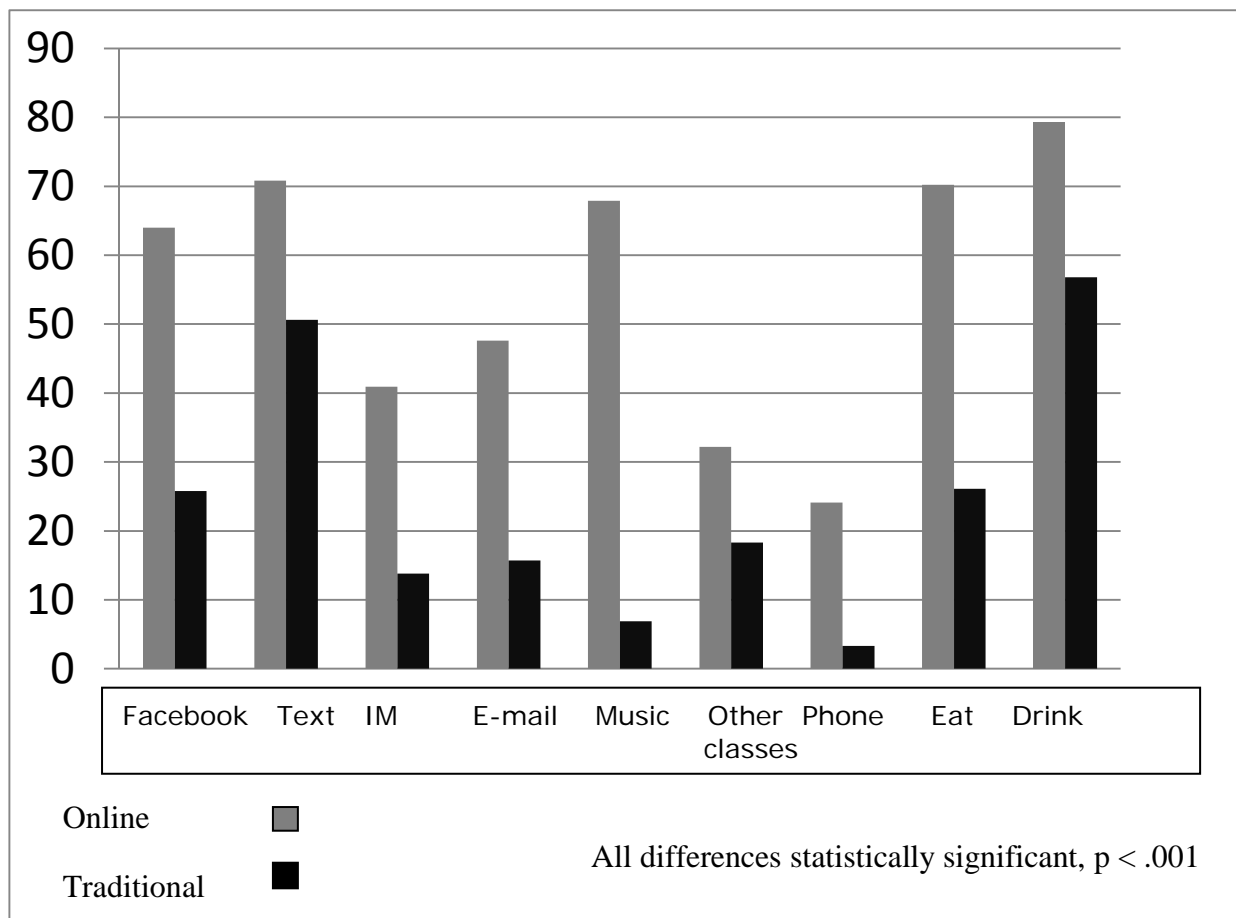
Behavior	n	%
Facebook	191	24.7%
Text message	392	50.6%
Instant message	102	13.2%
e-mail	116	15.0%
Listen to music	51	06.5%
Work on other classes	136	17.6%
Talk on the phone	25	03.2%
Eat	202	26.1%
Drink	440	56.8%

Because nearly 44% (n = 333) of the study population reported that they have taken online courses at the university, their multitasking while working on online courses was also assessed. The prevalence of multitasking while “on your computer engaged in your online classes” was higher than in the traditional classroom setting. Only two individuals reported no multitasking activity; when eating and drinking were removed from the analysis, five students (1.5%) reported not multitasking. Table 2 shows the numbers of students frequently or very frequently engaged in multitasking activities while working on their online classes. And Table 3 shows the comparison in multitasking frequency between traditional and online classes.

Table 2. Students Frequently or Very Frequently Engaging in Multitasking Behaviors While on Their Computers Doing Online Coursework; n = 333

Behavior	n	%
Facebook	209	62.7%
Text message	231	69.3%
Instant message	134	40.2%
e-mail	155	46.5%
Listen to music	222	66.6%
Work on other classes	104	31.2%
Talk on the phone	78	23.4%
Eat	234	70.2%
Drink	261	79.3%

Table 3. Percentages of Students Engaging in Multitasking Behavior: Comparisons Between Traditional and Online Classes



Risk Behaviors

Multitasking was associated with negative outcomes. Multitasking scores were negatively, significantly ($p < .01$) related to GPA. In other words, the more multitasking a person engaged in, the lower his or her overall GPA. In addition, multitasking was related to a number of high risk behaviors. Individuals with higher multitasking scores drank significantly more alcohol ($p < .01$), smoked more cigarettes ($p < .01$), used more marijuana ($p < .01$), and used more 'other drugs' ($p < .05$) than those with lower scores. High multitaskers were also significantly more likely to have engaged in binge drinking ($p < .01$), driving a car after drinking alcohol ($p < .01$), being driven in a car by someone who has drunk alcohol ($p < .01$), getting into physical fights ($p < .01$), and having multiple sex partners in the past 30 days ($p < .01$) than lower multitaskers.

Although there were no significant gender differences in the amount and frequency of multitasking, either in traditional classes or in online classes, and most high risk behaviors were associated with high multitasking in both genders, there were significant gender differences in a few of the high risk behaviors. High multitasking males were significantly more likely than high multitasking females to binge drink ($p < .05$), to drive cars after drinking alcohol ($p < .01$), and to be driven by others who have drunk alcohol ($p < .01$).

Discussion

Today's students are quite different than those who populated university classrooms at the turn of the century. Raised in the internet age, constantly "plugged in", seemingly inextricably attached to cell phones, and facile with all types of electronic media, these students nonetheless are expected to learn much of the same material as did their predecessors of the late 20th century.

Today's students' classroom behaviors, however reflective of their engagement and facility with current technology, may be putting students' learning at risk. And today's classrooms, configured for wireless computing or equipped with computers, may be enabling students to engage in behaviors that compromise learning.

Although many stories and anecdotes describe professors who find their students shopping online, playing games, texting friends, and checking Facebook, no prevalence data have indicated how widespread of a phenomenon classroom multitasking is. The purpose of this study was to describe the multitasking behaviors of university students while sitting in their traditional classrooms and while on their computers working on online classes. The finding that the majority of students multitask is not surprising; however, in an institution where the average class size was 22.7 during the semester that the study was done, it is surprising that more than 50% of the students sitting in class were frequently text messaging and more than one fourth were frequently checking Facebook, presumably while their professors looked on. Abaté (2008) claims that the consequence of tolerating multitasking in the classroom is an education that is limited in its adaptability, superficial, and short term memory based. The negative association between multitasking and GPA that was found in this study may not provide evidence for Abaté's (2008) specific claims, but it does provide some justification for those professors who are banning laptops and cell phones from their classrooms (Adams, 2006; Jan, 2011).

Banning phones and laptops in the classroom may meet with resistance because students may not be aware of the frequency of their multitasking, and if they are, they may not see it as problematic. Turkle (2011) comments that today's youth grew up in a culture of distraction and that technology is so much a part of life, it has become like a phantom limb. She refers to individuals as "tethered" to technology, and contends that for many, the "unplugged" world does not provide satisfaction. Turkle (2008) writes that a phenomenon such as e-mailing during classes is so mundane that it is scarcely noticed, and that once done surreptitiously, it is currently not something people feel they need to hide.

The proliferation of online classes and the significantly greater amounts of multitasking that take place among students engaged in online coursework may lead to some concern about the quality of attention and learning going on in online classes. Some of the focus group responses to the question asking participants what else they were doing while they were engaged in coursework were unique to students who took online classes. These included cooking dinner, caring for children, playing with pets, and conversing with family/roommates. These kinds of activities not only divert cognitive focus and attention, they also can physically remove the student from the act of engaging in the class.

The associations between multitasking and risk behaviors are disconcerting. College students worldwide have been known to engage in various risk behaviors, including alcohol, tobacco, and other drug use, unhealthy sexual practices, and disregard for preventive and protective habits (Centers for Disease Control, 1997; Steptoe et al, 2002). Indeed, the overall risk behavior of the current study population is similar to that of the general US college population. However, the significant correlations between multitasking and risk behaviors, and the significant differences in risk behaviors between high and low multitaskers support Foehr's (2006) findings that multitaskers tend to engage in risk behaviors, and point to an additional factor to examine when considering risk behaviors among college and university students. Clearly understanding that correlations do not support causality, these results may, however, lead one to wonder if multitasking in the classroom may be yet another risk that some university students are inclined to take. The results may also lead one to believe that classroom multitaskers must also be engaging in multitasking behaviors outside of the classroom – perhaps while driving, doing homework, or engaging in other activities whose effectiveness and safety multitasking may compromise.

The consideration of multitasking as a risk behavior is exacerbated by Greenfield's (2011) claim that the digital communication and entertainment devices frequently used by multitaskers have addictive properties that can distract users as well as alter their moods and consciousness. Wang & Tchernev's (2012) findings that college students' multitasking behaviors generate emotional gratification provide evidence that students have a powerful drive to repeatedly engage in multitasking behavior. The addictive and emotionally gratifying nature of multitasking make it all the more difficult, and perhaps all the more important, to address.

This study had several limitations: the sample was a nonrandom convenience sample, the data were self-reported, and the design was correlational. These limitations constrain inferences or generalizations regarding the entire university student population. Another limitation was that the multitasking behaviors that were listed on the survey might not adequately represent all of the multitasking activities in which the student respondents engaged. Despite the limitations, however, the results of this study can provide a starting point for further research as well as for discussions about learning in the 21st century, about standards for classroom behavior, and about the nature of risk behaviors. Ongoing research into the phenomenon of classroom multitasking may provide guidelines for the mitigation of the problems and their sequelae. Further research is needed to assess the associations between multitasking and risk behaviors; one suggestion would be to add multitasking items to the National Youth Risk Behavior Surveys and the College Health Risk Behavior Survey. Another important area for continued investigation is to examine the predictors of multitasking behaviors: what kinds of attitudes, beliefs, personality traits, and learning environments lend themselves to multitasking behaviors? And are said attitudes, beliefs, characteristics, and environments modifiable? University professors might also engage in small action research studies in their classrooms, experimenting with and assessing the effects of different pedagogical styles and approaches that might decrease multitasking among students.

Although it is very likely that students have been engaging in distracting behaviors in the classroom throughout the history of education, the ubiquity of technologies seems to make the possibilities for classroom multitasking even more likely in the near future. A recent white paper by the global telecommunications company, Ericsson (2011), projects that by

2020 there will be 50 billion connected devices, with individuals possessing between 5 and 10 devices each, so it's quite clear that the temptations and opportunities for multitasking will not abate and will not go away. The sheer number of electronic devices, their addictive nature, and the tethered selves that students have become can make addressing the issue of classroom multitasking quite daunting. For the sake of student learning outcomes, however, instructors should attempt to mitigate the problem to the extent possible. Some suggestions include having and enforcing clear written policies regarding multitasking behaviors and media use in the classroom, along with clear penalties for non-compliance with said policies. Instructors can utilize hands-on, active learning strategies that require that students be on task with tasks that minimize opportunities for engagement with electronic devices. And, if possible, professors can set up classroom seating that minimizes visual obstructions and maximizes opportunities for circulating around classrooms.

Many university professors are aware that their students are engaging in multiple behaviors while sitting in their classrooms; these professors should not avert their eyes, but rather help their students become aware of the consequences of multitasking. Perhaps engaging students in discussions about multitasking and seeking student input in addressing the issue can be a first step in resolving what has the potential to become a pernicious problem.

References

- Abaté, C. (2008). You say multitasking like it's a good thing. *Thought & Action*, 24 7-13.
- Adams, D. (2006). Wireless laptops in the classroom (and the Sesame Street Syndrome). *Communications of the ACM*, 49 (9), 25- 27. doi: 10.1145/1151030.1151049
- Bannister, R., & Remenyi, D. (2009). Multitasking: The uncertain impact of technology on knowledge workers and managers. *Electronic Journal Information Systems Evaluation*, 12(1), 1-12. Retrieved from <http://www.ejise.com>
- Baron, N. (2008). Adjusting the volume: Technology and multitasking in discourse control. In J. E. Katz (Ed.), *Mobile communication and social change in a global context* (pp. 177 – 195). Cambridge, MA: The MIT Press.
- Bowman, L.L., Levine, L. E., Waite, B. M., & Gendron, M. (2010) Can students really multitask? An experimental study of instant messaging while reading. *Computers & Education*, 54, 927-931. doi: 10.1016/j.compedu.2009.09.024
- Carson, V., Pickett, W., & Janssen, I. (2011). Screen time and risk behaviors in 10 –to 16-year old Canadian youth. *Preventive Medicine*, 52, 99-103. doi:10.1016/j.ypmed.2010.07.005
- Centers for Disease Control. (1997). Youth Risk Behavior Surveillance: National College Health Risk Behavior Survey – United States. *Mortality and Morbidity Weekly Report* 46(SS-6), 1–54.

- Dux, P. E., Ivanoff, J., Asplund, C. L., & Marois, R. (2006). Isolation of a Central Bottleneck of Information Processing with Time-Resolved fMRI. *Neuron* 52, 1109–1120. doi: 10.1016/j.neuron.2006.11.009
- Dzubak, C.M. (2008). Multitasking: The good, the bad, and the unknown. *Synergy: The journal of the association for the tutoring profession*, 1. Retrieved from <http://www.myatp.org/ejournal.htm>
- Ellis, Yvonne, Daniels, Bobbie W. and Jauregui, Andres (2010). The effect of multitasking on the grade performance of business students. *Research in Higher Education Journal*, 8. Retrieved from <http://www.aabri.com/manuscripts/10498.pdf>
- Ericsson. (2011). *More than 50 billion connected devices*. (White paper 284 23-3149 Uen) | Retrieved from Ericsson website: <http://www.ericsson.com/res/docs/whitepapers/wp-50-billions.pdf>
- Foehr, U. (2006). *Media multitasking among American youth: Prevalence, predictors and pairings*. (Report #7592). Retrieved from The Henry J. Kaiser Family Foundation website: <http://www.kff.org/entmedia/upload/7592.pdf>
- Greenfield, D. (2011). The addictive properties of internet usage. In K.S. Young & C.N. de Abreu (Eds.), *HIInternet addiction: A handbook and guide to evaluation and treatment*. (pp. 135 – 153). Hoboken, NJ: John Wiley & Sons, Inc.
- Jan, T. (2011, April 24). Tangled in an endless web of distractions: Colleges worry about always plugged in students. *The Boston Sunday Globe*, pp. A1, A10.
- Junco, R., & Cotten, S. (2011). Perceived academic effects of instant messaging use. *Computers & Education*, 56(2), 370-378. doi:10.1016/j.compedu.2010.08.020
- Just, M.A., Carpenter, P.A., Keller, T.A., Emery, L., Zajac, H., & Thulborn, K.R. (2001). Interdependence in nonoverlapping cortical systems in dual cognitive tasks. *NeuroImage*, 14, 417-426. doi:10.1006/nimg.2001.0826
- Kirshner, P.A., & Karpinski, A.C. (2010). Facebook and academic performance. *Computers in Human Behavior*, 26(6), 1237-1245. doi:10.1016/j.chb.2010.03.024
- Kraushaar, J.M., & Novak, D.C. (2010). Examining the affect (sic) of student multitasking with laptops during lecture. *Journal of Information Systems Education*, 21(2). 241-251.
- Levine, L. E., Waite, B.M., & Bowman, L. L. (2007). Electronic media use, reading, and academic distractibility in college youth. *Cyber Psychology & Behavior*, 10(4). doi: 10.1089/cpb.2007.9990
- Marois, R., Larson, J. M., Chun, M. M., & Shima, D. (2005). Response-specific sources of dual-task interference in human premotor cortex. *Psychological Research*, November 11, 1-12. doi: 10.1007/s00426-005-0022-6

- Ophira, Nass, and Wagner's (2009). Cognitive control in media multitaskers. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, 106, 15583–15587. doi: 10.1073/pnas.0903620106
- Pashler, H. (2000). Task switching and multitask performance. In S. Monsell & J. Driver (Eds.), *Control of cognitive processes: Attention and performance XVIII* (pp. 277-308). Cambridge, MA: The MIT Press.
- Poldrack, R. A., & Foerde, K. (2008). Category learning and the memory systems debate. *Neuroscience and Biobehavioral Reviews* 32, 197–205. doi:10.1016/j.neubiorev.2007.07.007
- Roberts, D. F., & Foehr, U.G. (2008). Trends in media use. *Future of Children*, 18(1), 11-37. doi: 10.1353/foc.0.0000
- Rosen, C. (2008). The myth of multitasking. *The New Atlantis*, 20, 105-110.
- Rubinstein, J. S., Meyer, D. E., & Evans, J. E. (2001). Executive Control of Cognitive Processes in Task Switching. *Journal of Experimental Psychology: Human Perception and Performance*, 27(4), 763-797. doi: 10.1037/0096-1523.27.4.763
- Steptoe A., Phil D., Wardle J., Cui W., Bellisle F., Zotti A., Baranyai R. & Sanderman R. (2002). Trends in smoking, diet, physical exercise, and attitudes toward health in European university students from 13 countries, 1990–2000. *Preventive Medicine* 35, 97–104. doi:10.1006/pmed.2002.1048
- Turkle, S. (2011). The tethered self: Technology reinvents intimacy and solitude. *Continuing Higher Education Review*, 75, 28-31.
- Turkle, S. (2008). Always-on/always-on-you: The tethered self. In J. E. Katz (Ed.), *Handbook of mobile communication studies*. (pp. 121 – 137). Cambridge, MA: The MIT Press.
- Wang, Z. & Tchevnev, J. (2012). The myth of multitasking: Reciprocal dynamics of media multitasking, personal needs, and gratifications. *Journal of Communication*. Advance online publication. doi: 10.1111/j.1460-2466.2012.01641.x