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Perceived academic effects of instant messaging use

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ABSTRACT

College students use information and communication technologies at much higher levels and in different ways than prior generations. They are also more likely to multitask while using information and communication technologies. However, few studies have examined the impacts of multitasking on educational outcomes among students. This study fills a gap in this area by utilizing a large-sample web-based survey of college student technology usage to examine how instant messaging and multitasking affect perceived educational outcomes. Since multitasking can impede the learning process through a form of information overload, we explore possible predictors of academic impairment due to multitasking. Results of this study suggest that college students use instant messaging at high levels, they multitask while using instant messaging, and over half report that instant messaging has had a detrimental effect on their schoolwork. Higher levels of instant messaging and specific types of multitasking activities are associated with students reporting not getting schoolwork done due to instant messaging. We discuss implications of these findings for researchers studying the social impacts of technology and those in higher education administration.

1. Introduction

Researchers are challenged to understand the radical shifts in how today's college students use information and communication technologies (ICTs) in comparison to previous generations and the educational and social impacts of this usage. An increasing number of studies have examined how college students, and youth more generally, use ICTs (Cotten, 2008; Jones & Fox, 2009; Lenhart, Arafeh, Smith, & Macgill, 2008; Pasek, More, & Hargittai, 2009; Roberts & Foehr, 2008). Today's college students use the Internet and instant messaging (IM), consult Wikipedia, play online games, maintain and regularly update blogs, and download music more than individuals from any other generation (Fox & Madden, 2009; Horrigan & Rainie, 2005; Jones & Fox, 2009; Junco & Mastrodicasa, 2007; Rainie & Tancer, 2007).

Although recent studies have illustrated high levels of technology usage among college students, there has been scant research examining the impacts of this usage on educational outcomes among students (for an exception see Pasek, More, & Hargittai, 2009). This study fills a gap in this area by utilizing a large-sample nationwide survey of college student technology usage to examine how a specific type of technology usage, instant messaging, affects educational outcomes. In addition to reporting technology usage data, we examine the extent to which students multitask while using instant messaging. Since multitasking can impede the learning process (Mayer & Moreno, 2003), we explore possible predictors of academic impairment due to multitasking to help identify students who may be at-risk.

1.1. Technology use among college students

General Internet use and specific applications of the Internet have dramatically increased among college students and young adults. Jones and Fox (2009) reported that between 2005 and 2008, the percentage of young adults online has increased by 6–7 percent for those aged 12–24. The Kaiser Family Foundation (Rideout, Foehr, & Roberts, 2010) found that computer use had increased 27 minutes per day on average between 2004–2009. Specifically, 15–18 year olds spent an average of 26 minutes per day on social networking websites, 17 minutes

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per day playing games, 15 minutes per day on video websites (like youTube), and 11 minutes per day on instant messaging (Rideout et al., 2010). Findings from others support the Rideout et al. (2010) results. For instance, Salaway, Caruso, and Nelson (2007) found that students spent an average of 18 hours per week on online activities while Junco and Mastrodicasa (2007) found that college-age instant messaging users typically spent an hour and 20 minutes each day actively chatting.

Social networking websites are one of the most popular online activities for college students (Jones & Fox, 2009; Lenhart & Madden, 2007; New Media Consortium, 2007; Rideout et al., 2010). Rideout et al. (2010) found that 53% of 15–18 year olds used social networking websites and among those, they spent an average of 48 minutes per day on the sites. Again, these findings are congruent with others such as Lenhart and Madden (2007) who found that sixty-five percent of youth aged 12–17 and 67% of young adults aged 18–32 used social networking sites. Social networking sites allow users to easily keep in contact with others, and they can effortlessly use IM while browsing profiles. The Higher Education Research Institute (HERI, 2007) reported that 94% of first-year students use social networking websites. These data are congruent with more recent statistics on social networking website use (Jones & Fox, 2009; Matney & Borland, 2009; Rideout et al., 2010).

Although collectively college students use technology at high rates, there are differences in the ways that women, members of ethnic minority groups, and those from lower socioeconomic levels use technology. For instance, women tend to use the Internet for communication while men tend to use it for non-communicative purposes such as shopping and playing games (Cooper & Weaver, 2003; Jackson, Ervin, Gardner, & Schmitt, 2001; Joiner et al., 2005; Morgan & Cotten, 2003). Additionally, those from minority groups and lower income levels have less access to and use the Internet less than their Caucasian and higher-socioeconomic level peers (Cotten & Jelenewicz 2006; Junco 2005; Junco & Mastrodicasa 2007; Kaiser Family Foundation 2004; Oblinger & Oblinger 2005; Sax, Ceja, & Teranishi 2001).

Of particular interest to researchers and higher education professionals has been the student adoption of information and communication technologies because of their widespread use, potential to influence relationships, potential to help build a sense of community, and possible academic applications (Salas & Alexander, 2008; Timm & Junco, 2008). Some of these technologies, like social networking websites and instant messaging, can be used in order to engage students in their college experience in ways that add to their overall engagement and learning outcomes (Astin, 1999; Heiberger & Harper, 2008; Hu & Kuh, 2001; Nelson, Laird & Kuh, 2005; Salas & Alexander, 2008). Even though the potential for positive outcomes exists, there is little research to support these benefits.

1.2. Technology use and academic outcomes

There is no consensus on the effects of technology usage on academic outcomes to date, though recent popular media reports would suggest negative impacts of technology usage among youth (see Young, 2009). This is partially due to the number of limited studies examining the educational impacts of technology usage. In addition, the few studies that have examined educational impacts have either failed to examine a range of specific types of technology usage or have been limited by measures and/or sampling designs utilized. Furthermore, new technologies are being created and used at such a quick pace that it is difficult for researchers to capture the effects of these rapidly changing technologies (Cotten, McCullough, & Adams, in press).

The most recent research in this area by Pasek et al. (2009) examined the relationship between Facebook use, one particular aspect of technology usage, and academic performance. Pasek et al. (2009) found that, contrary to popular media reports and a 2009 conference presentation (Karpinski, 2009), there was no relationship and specifically, *no negative relationship,* between this type of technology usage and grades. The Pasek et al. study was in response to widespread media coverage of an unpublished study that found negative effects of Facebook usage on grades (Karpinski, 2009). As Pasek et al. (2009) note, although Karpinski (2009) found a negative raw correlation between grades and Facebook usage, the study was limited due to the sampling strategy and analytical design.

Though Pasek et al. (2009) did not find an association between Facebook usage and grades, other earlier studies have found both positive and negative educational impacts of technology usage. Hu and Kuh (2001) and Jones and Madden (2002), both demonstrated some academic benefits of technology use. In a study using the College Student Experience Questionnaire (CSEQ), Hu and Kuh (2001) found that students who attended more "wired" institutions (those with more readily available information technology as rated by the *Yahoo! Internet Life* survey) were more likely to report good educational practices such as student/faculty contact, cooperation among students, and active learning than those who attended less wired institutions (although there could have been a multitude of other factors that may have explained these outcomes). In a large study of college students, Jones and Madden (2002) reported that almost 79% of students thought that the Internet had a positive impact on their academics. Lastly, Heiberger and Harper (2008) and HERI (2007) both found positive correlations between the use of social networking websites and student engagement, a predictor of academic success (Kuh, 2009).

In contrast, other studies suggest that the Internet may negatively affect some college students' academic progress, as well as their interactions with each other and with faculty members. Malaney (2004–2005) found that 8.9% of students in 2000, and 4.4% in 2003, reported that their grades had suffered as a result of too much time spent on the Internet. Kubey, Lavin, and Barrows (2001) conducted a survey of 576 mostly first-year students and found that 9% agreed or strongly agreed that they may be "a little psychologically dependent on the Internet." Compared with the nondependent group, four times as many students in the Internet-dependent group reported Internet-related academic impairment. Additionally, the group of students who reported that their schoolwork had been hurt by Internet use also reported that they used the Internet at rates more than double that of the sample as a whole (Kubey, Lavin, & Barrows, 2001). Gordon, Juang, and Syed (2007) reported similar findings—using the Internet for coping purposes was correlated with higher levels of depression, which can affect cognitive processing and, therefore, educational outcomes.

We know little about the specific types of technology that may be implicated in academic success and/or failure. However, we suggest that instant messaging is one such technology that should be related to academic outcomes. Instant messaging is significant in the daily lives of today's college students, who actually prefer to use IM instead of email to stay in touch with their friends (Carnevale, 2006; Horrigan & Rainie, 2005; Junco, 2005). Researchers have found that between 59% and 75% of college-aged students use IM (Jones & Fox, 2009; Junco & Mastrodicasa, 2007). First-year college students spend an average of 16.3 hours per week chatting via IM versus only spending 3.9 hours using email (Morgan & Cotten, 2003).

Because of the nature of the technology, instant messaging lends itself to be used frequently during multitasking. It is common for college students to report "chatting" with a large number of friends simultaneously (Junco, 2005). Junco and Mastrodicasa (2007) found that 75% of

IM users reported chatting on IM while doing schoolwork. Given the ease with which students multitask while using IM, it is important to understand whether this kind of use is having an effect on their learning. We know that youth tend to not use this technology in isolation. Youth who frequently use technology are often likely to multitask, with 31% reporting that they multitasked while doing homework (Cotten, Anderson, & Shipes, 2010; Rideout et al., 2010).

1.3. Multitasking and educational outcomes

Youth use a variety of technologies while they are doing homework, talking on the phone, playing games, and other activities (Cotten, Anderson, & Shipes, 2010; Rideout et al., 2010). Research has found that students multitask frequently while using IM (Junco & Mastrodicasa, 2007). In fact, some research suggests that IM is the most popular online multitasking activity for youth (Grinter & Palen, 2002). While not specifically examining multitasking, one study found that level of IM use was related to academic impairment (Huang & Leung, 2009).

Evidence is mixed regarding whether being able to multitask is positive or negative for individuals, especially youth. Some suggest that although it does allow us to engage in more activities at once, multitasking is not without costs; no matter how good individuals become at multitasking, they might not ever be as effective and efficient as when they do one thing at a time (Jackson, 2008). Being in a state of constant partial attention from multitasking, individuals increase the mental work necessary to switch back and forth between activities (Jackson, 2008). Ophir, Nass, and Wagner (2009) found that heavy media multitaskers have distinctly different information processing styles and show a deficit in their task-switching ability; however, they concluded that this could either be a difference in orientation to information processing or a fundamental deficit.

Mayer and Moreno's (2003) research-based cognitive theory of learning and information overload suggests that multitasking may also have a negative impact on learning. There are three kinds of attention demands during the learning process: *essential processing* refers to the basic attention processes required for learning (i.e., focusing on the information to be learned), *incidental processing* is not required for learning and instead refers to extraneous variables in the learning experience (for instance, adding music to a presentation—the music is an extraneous variable that engages *incidental processing*), and *representational holding*, which is analogous to working memory (cognitive resources being used to remember information for the learning process). Mayer and Moreno's (2003) integrated theory of learning states, and their research shows, that humans have a finite amount of cognitive processes available at any one time and that these processes can be overloaded. Once these processes are overloaded, deeper processing and learning cannot occur.

Given the high levels of IM among youth, Mayer and Moreno's theory of learning, and the preliminary research in this area, we hypothesize that the use of this technology in conjunction with attempting to complete schoolwork will result in detrimental educational outcomes. However, no research to our knowledge has examined the specific usage of IM with homework to determine their combined impact on educational outcomes. Therefore, we will examine whether students' reports of multitasking while using IM affect their completion of homework. We include control variables that are related to technology ownership and use, such as gender, socioeconomic status, and race/ethnicity (NTIA, 2004). Given earlier research (Kubey et al., 2001) showing that students who used the Internet at higher levels reported more academic impairment, we hypothesize that those who use IM more often will report more detrimental educational outcomes.

2. Methods

2.1. Design and sample

A cross-sectional web-based survey was designed to examine technology usage among college students. Administrators ($n = 37$) who attended a higher level administrators roundtable at a national conference were asked if they would be willing to have their institutions participate in a study focused on technology usage among college students. Four administrators were willing to have their institutions participate. Three of the institutions were large four-year public universities while the fourth was classified as a medium four-year public university (based on Carnegie Classifications). Three of the institutions were in urban settings and primarily nonresidential, and one was in a rural setting and was primarily residential. Two of the universities were located in the Midwestern, one was located in the Southeastern, and one in the Southwestern United States. All students at two universities and then randomly selected samples (because of procedural concerns— i.e., sending out too many email requests for research participation in one semester) of students at the two other institutions were surveyed ($N = 38{,}345$). Students were contacted through their on-campus email accounts during the Fall 2006 and Spring 2007 semesters and were sent a link to a survey hosted on a commercial survey-hosting website. Two additional reminders were sent, each a week apart. A total of 4,491 students at the universities responded to the survey, with an overall response rate of 11.4%. Students were not compensated for their participation in the survey. The samples for each institution were representative of the larger institutional population in terms of gender, race/ethnicity, and family income. For these analyses, we only use those who report that they used IM (70% of the sample after listwise deletion of cases with missing data).

2.2. Measures

The outcome being examined in this study is whether IM interferes with students completing their homework. This was assessed by one item that asked respondents how often their use of IM had interfered with them completing their homework assignments. We recoded the question used for the dependent variable (How often do you not get your schoolwork done because you were instant messaging) into a dichotomous variable because we were interested in assessing whether or not students believed their schoolwork was impaired. If a student answered either "Very frequently, somewhat frequently, sometimes, or rarely," (each of these was a separate response option) we recoded the response as "1" (or "Yes") and if they answered "Never," we recoded the response as "0" (or "No"). This measure was developed specifically for use in this study given the lack of existing measures.

Key independent variables included IM usage, multitasking, high speed Internet access, and sociodemographics. Instant messaging usage was assessed via one question that asked respondents how much time (measured in minutes per day) they spend actively sending and receiving instant messages (via any platform including AOL, MSN, Facebook, etc.) on a typical day. Few studies have empirically examined multitasking among youth. To assess this in the current study, respondents were asked how often they: (1) work on schoolwork at the same time they use IM; (2) do other things on the computer or Internet (such as playing games or browsing the Internet) at the same time they are IMing; and (3) do other things not on the computer or the Internet (such as talk on the phone or watch TV) at the same time they are IMing. Response options for all three questions included: very frequently (100% of the time), somewhat frequently (75%), sometimes (50%), rarely (25%), and never. The multitasking questions were coded as 1 = "never," 2 = "rarely," 3 = "sometimes," 4 = "somewhat frequently," and 5 = "very frequently." Higher scores reflect more frequent multitasking. They were also asked whether or not they had high speed Internet access in their residence (1 = yes).

Sociodemographics included measures of gender (1 = male), age (measured in years), ethnicity, class standing, and parental/household income (measured in 10 categories ranging from less than $10,000 to $200,000 and higher). Due to low percentages, Native Americans and Other Ethnicity were combined into the Other category. Similarly, income categories were collapsed at both the lower and higher ends (less than $9999, $10,000–$14,999, and $15,000–$24,999 were combined into $24,999 or less; responses of $150,000 and higher were collapsed into a $150,000 and higher group). To minimize the effect of outliers and because of the skew of the distributions, age was capped at 25 and IM minutes per day was capped at 180 by recoding responses greater than these values to the maximum values.

2.3. Data analyses

We first examine descriptive characteristics of the sample, using univariate and bivariate analyses. Analyses of Variance (ANOVA) with Tukey's Honestly Significant Difference (HSD) post-hoc tests were used to evaluate differences in demographic variables and multitasking behaviors between students who did and did not report that multitasking interfered with their schoolwork. Logistic regression analyses were conducted to examine IM use, multitasking, high speed Internet access, and sociodemographic differences in the odds of not getting schoolwork done because of multitasking.

3. Results

3.1. Descriptive statistics

Descriptive characteristics of the entire survey sample and of those who use IM are reported in Table 1 and thus not repeated here. We conducted one-way ANOVA's to assess whether there were differences in demographic data between the subsample of IM users and the entire survey sample. These analyses revealed no differences between the two groups.

Instant messaging users spent a mean of 120 minutes per day actively chatting. IM users were adept at multitasking. In this sample, 97% of IM users reported multitasking by doing something else on the computer while chatting, while 93% reported multitasking by engaging in a non-computer related activity (watching television, talking on the phone, etc.) while chatting. Multitasking while using IM is not isolated to casual activities. Almost all IM users (93%) reported that they had actively chatted and performed schoolwork at the same time. The majority of IM users (57%) reported that doing schoolwork while IMing had a detrimental effect on their schoolwork.

We next examined whether there were differences in who reported that IMing had a detrimental effect on their schoolwork at the bivariate level (see Fig. 1). Results show that multitasking while IMing was related to academic impairment at the bivariate level. Students who reported that they do schoolwork while IMing very frequently and somewhat frequently were more likely than those who do this sometimes, rarely, or never to report academic impairment due to IM use. Also, as students' level of reporting that they did something else on the computer while IMing increased, so did their reports of academic impairment due to IM use. Similarly, students who reported doing other things, not on the computer, while IMing very frequently, somewhat frequently, and sometimes were more likely than those who did this rarely or never to report academic impairment as a result of IM use.

A number of the control variables were significant in the bivariate analyses. Females were more likely to report a detrimental impact of IM on their schoolwork compared to males. Over 50% of each age group, other than those age 25 and older, reported that multitasking while IMing was detrimental to their completing their schoolwork. Class standing was also significant in the bivariate analyses (see Fig. 1).

3.2. Determinants of educational impairment: results from logistic regression

Logistic regression results (see Table 2) indicate that both minutes per day IMing and two of the three multitasking variables (IMing while working on schoolwork and IMing while doing a non-computer related task) are related to the odds of reporting academic impairment. The greater the amount of time spent actively chatting via IM each day, the more likely students were to report impairment. Students who reported doing more multitasking by doing schoolwork while IMing and doing non-computer related tasks while IMing were more likely to report that their schoolwork had suffered.

In addition to the effects of IM and multitasking, several of the control factors were related to students reporting that their schoolwork had suffered as a result of IM use. More specifically, gender, age, class standing, and income were associated with reports of not getting schoolwork done due to IM use. Males and older students were less likely to report that multitasking had hurt their schoolwork. Interestingly, even though older students were less likely to report impairment, sophomores were more likely than first-year students to report that their schoolwork had suffered because of multitasking. Students in the $35,000–49,999 and $100,000–149,999 income brackets were more likely to report that multitasking had a negative effect on their schoolwork than were those in the $50,000–$74,999 income bracket. The fact that income was not significant in the ANOVA and was significant in the logistic regression demonstrates that income explains some of the variance in academic impairment not explained by the other variables.

Table 1
Demographic data for the entire survey sample (4,491) and for subsample of students who use IM (N = 2,939).

Variable	Entire sample (%)	IM users (%)
Gender		
Male	38	38
Female	62	62
Age		
18	17	20
19	14	17
20	14	17
21	13	15
22	10	10
23	6	5
24	4	4
25	3	2
26+	19	11
Ethnicity		
White	77	78
African-American	7	5
Latino-American	7	7
Asian-American	3	4
Other	7	6
Class Standing		
First-year	22	25
Sophomore	15	17
Junior	23	23
Senior	29	27
Graduate Student	11	9
Household Income		
<$24,999	11	10
25,000–34,999	8	9
35,000–49,999	13	12
50,000–74,999	23	23
75,000–99,999	17	17
100,000–149,999	16	17
>$150,000	12	13
Multitasking		
Computer	97	97
Non-Computer	93	93
Schoolwork & IM	93	93
Technology		
Have high speed access in residence	91	94
IM detrimental effects on schoolwork		
Yes	57	57

Note: There were no significant differences between the entire sample and the subgroup of those who use IM on any of the variables in this table (F values all < 1, p values all $>.9$)

4. Discussion

We found that students multitask while using IM a great deal and the majority of the sample reported that using IM was detrimental to their schoolwork. IM affords college students a unique ability to keep connected to social network members, whether they be friends from their high school, pre-high school, or college years. Maintaining these connections is of particular importance in relation to student persistence, as a connection to other students early in college is a strong predictor of retention (Kuh, 2009; Pascarella & Terenzini, 2005; Peltier, Laden, & Matranga, 1999; Tinto, 2006–2007). Students may be using IM in that very way—to help in their coping with, and adjustment to, a new social environment. Indeed, IM use among students has been associated with increased contact with strong and weak social network ties and a feeling of mattering, which enhances self-esteem and lowers depression (Cotten, 2008).

Although IM use may be beneficial for enhancing social connections and well-being as Cotten (2008) suggests, our research suggests that the amount of time spent IMing is not necessarily beneficial for completing homework. In addition, multitasking while using IM, whether when doing schoolwork or doing non-computer related activities, appears to be detrimental for completing homework. Interestingly though, multitasking while doing other tasks on the computer was not a significant predictor of impairment and could be interpreted as a sign that students do this so much they don't consider it harmful, at least to their academics. Or, it may be that the activities that they are doing on the computer positively contribute to their completing their homework, such as gathering research materials or communicating via social networking sites or other computer mediated communication venues with their classmates about homework and other things. However, they may not consider these activities as part of their "homework." Unfortunately the data do not allow us to determine which, if either, of these processes may be operating. Future researchers should further explore this result in order to better understand the inter-relationships between computer use, multitasking, and academic outcomes.

Our results also show that males and older students report lower impairment as a result of their IM use. However, sophomores were more likely than first-year students, and those from the $35,000–$49,000 and $100,000–$149,999 income brackets were more likely than those in the $50,000–$74,999 bracket to report academic impairment due to IM use.

Given previous research on how men use technology in general and Internet technology more specifically, it would seem that men would report a higher occurrence of having IM interfere with their schoolwork (Cotten, Anderson, & Tufekci, 2009; Jackson et al., 2001; Joiner et al.,

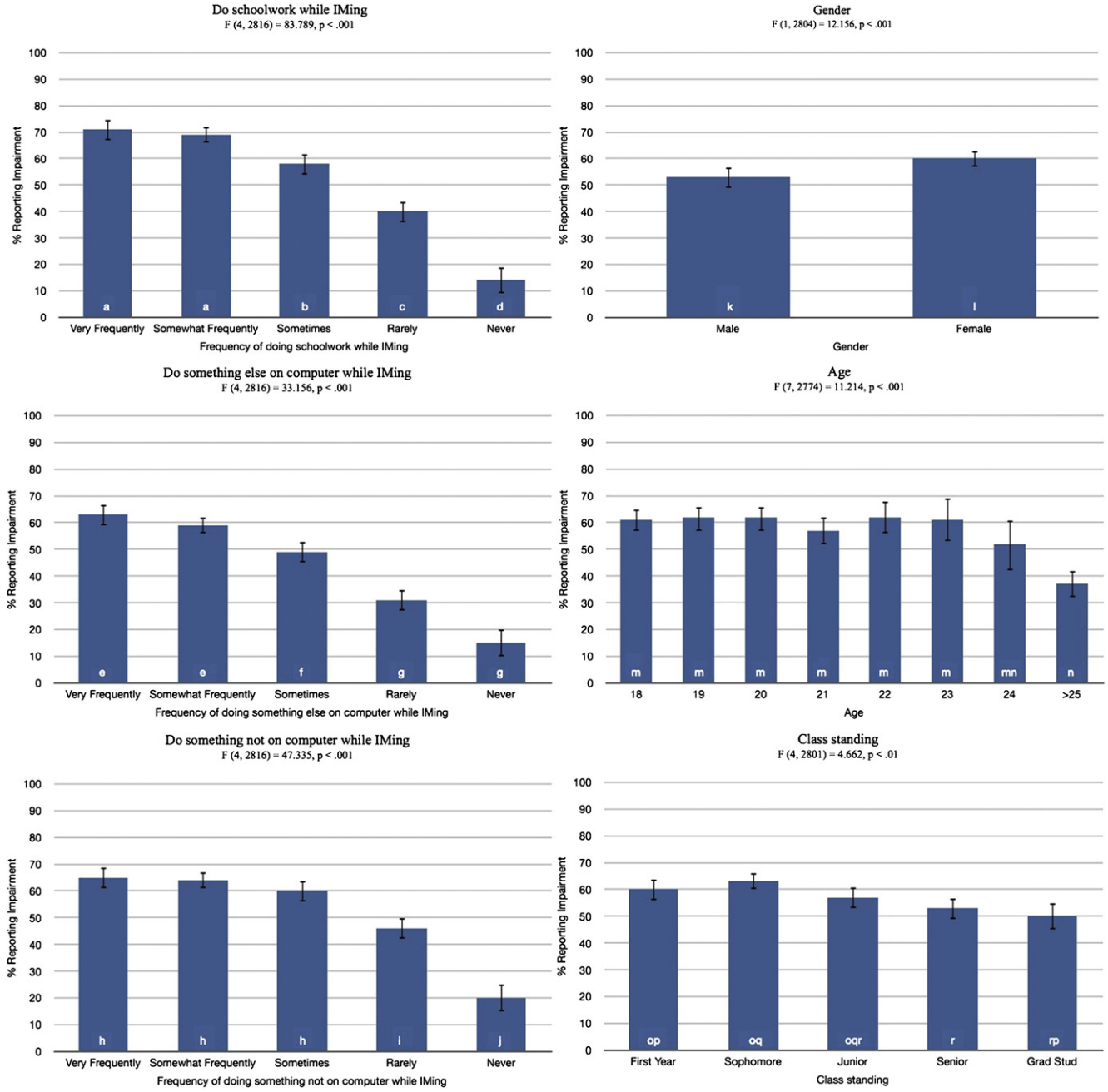

Fig. 1. Distributions of percentage of students reporting that multitasking while using IM had a detrimental effect on their schoolwork, results of ANOVA's, and Tukey's post-hoc comparisons for multitasking questions and demographic variables. *Note:* Only variables with significant differences are shown. Means that do not share subscripts differ at $p < .05$ in the Tukey honestly significant difference comparison. Error bars are 95% confidence intervals of the means.

2005; Morgan & Cotten, 2003). However, this was not the case in the present study. While no previous research is available regarding impairment, class standing, and student technology use, it would also seem that first-year students would be more likely than other class levels to report impairment because of the need to overcome transition issues in their first year. However, sophomores were more likely than were first-year students to report impairment.

On the other hand, a number of the relationships were in the predicted direction. For instance, research reported by Mayer and Moreno (2003) suggests that students who multitask would report a negative impact on their schoolwork while research by Ophir, Nass, and Wagner (2009) shows that heavy multitaskers are unable to filter out extraneous information. This would be especially true for students who completed their schoolwork while engaging in other activities. Indeed, our results show that those who report high levels of multitasking while IMing were more likely to report that IMing hurt their ability to complete their schoolwork. Congruent with the findings of Huang and Leung (2009), students who spent more time actively chatting on the Internet also reported a significantly higher, yet slight, increase in the probability that their schoolwork was impaired due to IM use. Of particular interest is the fact that those who multitask a great deal (i.e., using various media sources or distractors) are more likely to report that their schoolwork had suffered because of it.

Table 2
Results of logistic regression exploring the relationship of students' IM use, multitasking behaviors, and sociodemographic factors to their odds of reporting not getting schoolwork done due to IM (N = 2,676).

Independent variables	β	SE	Wald	OR	95% CI	Inverse OR
Minutes per day chatting	0.005	0.001	29.988***	1.005	1.003–1.006	
Multitask – IM & Schoolwork	0.369	0.052	50.012***	1.447	1.306–1.603	
Multitask – IM & Comp. task	0.051	0.057	0.816	1.053	.942–1.177	
Multitask – IM & Non-Comp.	0.117	0.047	6.122 *	1.125	1.025–1.234	
Male	-0.226	0.101	4.995*	0.798	.654–.973	1.253
Age	-0.073	0.037	3.955*	0.930	.865–.999	1.075
African-American	0.268	0.235	1.307	1.308	.826–2.072	
Latino-American	0.359	0.188	3.628	1.431	.990–2.070	
Asian-American	0.139	0.263	0.279	1.149	.686–1.922	
Other Ethnicities	0.025	0.203	0.015	1.025	.668–1.527	
Sophomore	0.393	0.162	5.875*	1.482	1.078–2.036	
Junior	0.132	0.174	0.575	1.141	.811–1.604	
Senior	0.239	0.200	1.429	1.270	.858–1.878	
Graduate Student	0.547	0.283	3.717	1.727	.991–3.011	
<$24,999	0.062	0.187	0.108	1.064	.737–1.535	
$25,000–$34,999	0.011	0.197	0.003	1.011	.687–1.487	
$35,000–$49,999	0.416	0.173	5.756*	1.516	1.079–2.130	
$75,000–$99,999	0.166	0.152	1.192	1.181	.876–1.591	
$100,000–$149,999	0.422	0.156	7.324**	1.524	1.123–2.069	
>$150,000	0.068	0.169	0.161	1.070	.769–1.490	
Have high speed access	0.151	0.208	0.527	1.163	.774–1.748	
Constant	-0.902	0.764	1.395	0.406		
Likelihood ratio Chi-square	276.348***		Nagelkerke $R^2 = 0.172$			

*$p < .05$ **$p < .01$ ***$p < .001$.

There are a few possible explanations for our findings. Students in this sample seem to be aware that divided attention is detrimental to their academic achievement; however, they continue to engage in the behavior. The research conducted by Mayer and Moreno (2003) shows that paying attention to IM and to schoolwork at the same time will yield reduced capacity for *essential processing* and *representational holding* while increasing the *incidental processing* necessary for a given task. Engaging in IM use while trying to learn increases the student's cognitive demands especially in the area of incidental processing. This suggests that the learner has less cognitive resources to engage in the essential processing necessary to focus on information and, in turn, to engage in deep, meaningful learning. Students also learn less when they are holding representations in working memory and trying to engage in essential learning—for instance, when they are IMing and trying to follow a conversation while working on homework (Mayer & Moreno, 2003). Therefore, those who multitask at higher rates would require more mental work (Jackson, 2008) and yield less educational benefit (Mayer & Moreno, 2003).

It is plausible that there is a group of students with a "multitasking personality" who are multitasking "all over the place" even though they are cognizant of how these behaviors impact their schoolwork. Research by Neo and Skoric (2009) suggests that there is at least one personality variable (oral communication apprehension) that is related to increased and problematic IM use. If students dislike communicating orally they may turn to IM as a way to maintain social contacts, without having to communicate via phone or face-to-face. Unfortunately our data do not permit us to determine if this is actually the case with the students in this sample.

Or, it may be that the group of intense multitaskers in this sample may be throwing caution to the wind in terms of the effect of these negative behaviors on their schoolwork. Frequent multitaskers might make it a habit to spread their attention across various domains, thinking that it benefits their performance, when instead it impairs it. Certainly, there is evidence to show that engaging in multitasking may fuel a deficit in information processing (Ophir, Nass, & Wagner, 2009). Herein lies a catch-22—although research has suggested that using IM can be beneficial for the psychological well-being of certain types of students (Cotten, 2008), clearly there is a subgroup of students, who are heavy users that are negatively affected by IM use. This effect is greatest for IM use that cannot be regulated while attempting to engage in the learning process (Campbell, Cumming, & Hughes, 2006; Koch & Pratarelli, 2004; Morgan & Cotten, 2003; Ophir, Nass, & Wagner, 2009; Shaw & Gant, 2002).

5. Conclusion

Although our findings contribute to the nascent literature on the relationships between technology usage and academic impairment, there are limitations to this study. The available measures of technology usage are rather limited. Ideally, studies of this type should examine a variety of types, amounts, and timing of technology usage to determine their impacts on academic outcomes, rather than just IM use. Second, longitudinal studies are needed that follow students over time from high school through college to ascertain the causal processes involved in these relationships. Third, although this study is one of the largest of its kind, particularly examining this topic, the survey response rate is lower than we would have liked. Though research shows that survey response rates are dropping at alarming rates (Curtin, Presser, & Singer, 2000; Keeter, Kennedy, Dimock, Best, & Craighill, 2006), we do not know if students who did not respond to this survey are different in terms of their technology usage and how it impacts their academic outcomes than those who responded. Finally, it is important to note that academic impairment was assessed via self-report and not through an objective school performance variable such as grade point average (GPA). Future studies should include both objective and subjective academic impairment outcomes when possible in order to gain a better understanding of the academic impacts of multitasking.

Our findings present a number of directions for future research. It will be important for other researchers to replicate these findings and to elucidate the nature of the relationships between multitasking, IM use, and academic impairment. Additionally, the nature of our analysis is inherently correlational and cross-sectional. Future researchers will want to assess the causal patterns of technology-related academic

impairment. This study based its findings on a basic self-report measure of academic impairment. Future research should also include measures of objective academic performance, in addition to students' self-reported academic outcomes. Lastly, further studies will be needed to investigate how and when multitasking hinders academic performance in order to provide adequate education and intervention for those students.

While this study is a first step in researching the academic effects of information and communication technologies, it is important to consider some of the implications. For example, it is important for higher education faculty and staff to be aware of how their students are using technology. Some students are clearly aware that technology is having a detrimental effect on their academic performance and may be more open to interventions that will help them learn better strategies for managing their time and cognitive workload. Having discussions with students about what factors are impacting their academic performance is a necessary first step in supporting them throughout their college careers.

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