Gender, technology use and ownership, and media-based multitasking among middle school students

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ABSTRACT

We propose and test a new explanation for why more girls than boys multitask with media. We argue that gender differences in technology use and ownership function as the proximal cause for these gender differences in media multitasking. Prior literature suggests different patterns of technology ownership, such as more girls owning MP3 players and cell phones and more boys owning gaming systems. Further, on average, girls spend more time listening to music and communicating over media, while boys spend more time playing games. Those with the highest levels of ownership and use of a specific type of media may be the most likely to multitask with that media. We test our argument with a sample of middle school students, a group underrepresented in multitasking studies. The data support our arguments with ownership and use partially explaining the greater percentage of girls that multitask with music and communication media. Contrary to our predictions, the percentage of boys and girls who multitask while gaming did not significantly differ. We discuss potential explanations and conclude with implications for future research on gender differences in multitasking, youth and multitasking, and technology and media multitasking.

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1. Introduction

Increasingly youth engage with a variety of media platforms and applications at the same time. Whereas multitasking itself is not new, the proliferation of multitasking among children and young adults aided by new technology is fairly recent (Foehr, 2006; Jeong & Fishbein, 2007; Rideout, Foehr, & Roberts, 2010; Roberts & Foehr, 2008). This prevalence has sparked new research into understanding the forms, antecedents, and consequences of multitasking and whether, how, and why they differ by gender. We ask: how does the relationship between media-based multitasking and technology use and ownership differ for middle school girls and boys?

We make two primary contributions to the gender and media-multitasking literature. First, in spite of the youth culture associated with ubiquitous technology use, much of the previous research that considers specific technology use and multitasking has focused on college-students or adults (Carrier, Cheever, Rosen, Benitez, & Chang, 2009; Junco & Cotten, 2011, 2012; Karpinski,

Kirschner, Ozer, Mellott, & Ochwo, 2012; see Brasel & Gips, 2011 for a comparison; and see Pea et al., 2012 for an exception), not on adolescents who are rapidly embracing these technologies. We focus on middle school youth because they are expanding their technology use (Rideout et al., 2010) and their multitasking (Foehr, 2006), as well as negotiating their gender identities (Arnett, 2009). Second, most research on media-based multitasking and gender simply reports differences in time spent multitasking or measures of multitasking ability. This study investigates use and ownership patterns of technology platforms as a potential explanation for gender differences in media-based multitasking.

1.1. Media-based multitasking and youth

Multitasking involves switching between tasks, alternating attention from one task to the next (Jackson, 2008; see also Judd, 2013). Being able to respond to new, more time sensitive tasks and interruptions and then returning to prior tasks can be valuable in school, work, and social arenas (Klingberg, 2008). However, cognitive research suggests that constantly shifting one's attention can tax one's capacity for processing, remembering, and thinking deeply about content (Chun, Golomb, & Turk-Brown, 2011; Lee, Lin, & Robertson, 2011; Mayer & Moreno, 2003; Ren, Zhou, & Fu, 2009).

Due to this cognitive drain, many have found that some types of multitasking can have a negative influence on academic (Junco & Cotten, 2011; Junco & Cotten, 2012; Lee et al., 2011; Sana, Weston, & Cepeda, 2013; Wood et al., 2012; but see Bowman, Levine, Waite, & Gendron, 2010 for an exception) and socioemotional outcomes (Pea et al., 2012).

Increased engagement with media technologies (Lenhart, Purcell, Smith, & Zickuhn, 2010; Rideout et al., 2010; Roberts & Foehr, 2008) has facilitated increased multitasking among youth. Rideout et al. (2010) found that 11- to 14-year old US children are exposed daily to 12 h of media in less than 9 h of time, indicating the use of multiple medias simultaneously. Similarly, Jeong and Fishbein (2007) found that 76% of total time spent on media (digital and otherwise) is spent multitasking (about 28 h per week). As one is exposed to more types of media and as one spends more time using media, media multitasking increases (Rideout et al., 2010; Roberts, Foehr, & Rideout, 2005).

Generally, younger people spend more time multitasking than older generations (Carrier et al., 2009), although some evidence suggests that both youth and older adults multitask more that young and middle aged adults (Voorveld & van der Goot, 2013). Youth, however, tend to have the highest levels of multitasking with certain types of media, including websites, social media, and music (Voorveld & van der Goot, 2013). Furthermore, youth switch between media more frequently and faster than older adults (Brasel & Gips, 2011). In spite of the relationship of youth to both technology and technology-based multitasking, most studies of multitasking are limited to college students and older adults (Adler & Benbunan-Fich, 2013; Brasel & Gips, 2011; Carrier et al., 2009; Judd, 2013; Judd & Kennedy, 2011; Junco & Cotten, 2011, 2012; Sana et al., 2013; Wood et al., 2012). Research on multitasking among children and teenagers is limited to multitasking's role in other outcomes (Collins, 2008; Rosen, Carrier, & Cheever, 2013; Zhang, Jeong, & Fishbein, 2010), or multitasking's prevalence based on demographics (Rideout et al., 2010) and psychological factors (Jeong & Fishbein, 2007).

1.2. Media-based multitasking and gender

Gender, historically an important factor in the digital divide (Bain & Rice, 2006; Jackson, Ervin, Gardner, & Schmitt, 2001; Schumacher & Morahan-Martin, 2001), no longer plays a significant role in *overall* technology access and use. However, gender differences still exist in the use of particular types of technology. For example, Cotten, Anderson, and Tufekci (2009) found that there were few gender differences in communication uses of mobile phones, but males still exhibited greater use of mobile phones for recreational uses such as gaming, photos, and video. Hargittai and Walejko (2008) discovered that although there was gender parity regarding access to information and communication technologies, certain activities, such as sharing creative digital content online, still show marked gender differences. Moreover, these differences disappeared when the web user's ability was taken into account.

Although older teen girls are more likely to create and maintain blogs compared to older teen boys, boys are more likely to share and upload videos using websites such as YouTube (Lenhart, 2007). Among 8 to 18 year olds, boys spend more time using computers than do girls, but much of this time is spent gaming. Girls, however, report spending more time on social networking sites, listening to music, and online reading than boys (Rideout et al., 2010).

Many studies suggest mechanisms by which boys and girls differently engage with media technology. Within western society, for example, different gaming markets and cultures have developed for boys and girls (Cassell & Jenkins, 2000; Eden, Maloney, & Bowman, 2010). One mechanism would be the influence of game

marketers and producers as they create media targeted for one gender: as more boys or girls engage with that media, gendered norms influence who uses what. Another mechanism could be the documented psychological differences between boys and girls related to their engagement with technology. Neural and hormonal differences between boys and girls lead to cognitive preferences (Kimura, 2000) which at some level influence technology use. Boys and girls also differ on interpersonal needs such as control, affection, and inclusion, suggesting media and technology that better address those needs would be adopted at a higher rate (Lucas & Sherry, 2004). And, numerous social and behavioral studies have focused on the importance of gender socialization for youth from parents, peers, schools, and the media (Dietz, 1998; Eccles, Jacobs, & Harold, 1990; Schumacher & Morahan-Martin, 2001; Vekiri & Chronaki, 2008).

Regardless of the mechanisms at play, technology differences should correspond to differences in particular types of media-based multitasking. Limited research has shown that gender influences multitasking behavior among middle school students. Rideout et al. (2010) report that among 7th to 12th grade students girls are more likely to report multitasking than boys. In a sample of 14- to 16-year olds, girls spend more time multitasking than boys (Foehr, 2006), yet teenage girls tend to multitask with different types of media than boys (Foehr, 2006; Jeong & Fishbein, 2007).

Foehr (2006) connects these findings by suggesting the gender differences in multitasking are due in part to the types of media that girls use: instant messaging, email, websites, and music. These types of activities may lend themselves to multitasking because one can either pay less attention to them if something else is more pressing (e.g., music) or switch back and forth because they do not require continuous attention (e.g., instant messaging, email, and websites). Video and computer games, on the other hand, require a great deal of attention and concentration. This paper addresses a proximate cause of gender differences by exploring how inequality in use and ownership of technology platforms alter both overall and specific-media patterns of multitasking.

2. Hypotheses

We examine whether gender differences exist in multitasking, but also *how* they differ. No study of this age group has explored in detail the relationship between gender, technology use and ownership, and media-based multitasking. In order to discriminate between different relationships we include three types of variables on different aspects of technology and media. First, we consider the ownership of different platforms such as desktop computers and cell phones. Second, we also consider time spent using these platforms. Third, we classify the activities involved in media multitasking, such as surfing the web and talking on the phone, without reference to the platform on which these occur. We start with a set of baseline hypotheses about the relationship of gender to technology ownership and usage before considering the effects of multitasking. First, based on the prior research on technology ownership and use among boys and girls,

Hypothesis 1. More girls will own and use communication and music platforms compared to boys.

Hypothesis 2. More boys will own and use gaming platforms compared to girls.

Note that we make no hypotheses about gender difference in use or ownership of the most general platforms, laptops and desktops. Next, the research on engagement with technologies and multitasking leads us to propose,

Hypothesis 3. (a) Greater ownership and use of any technology platform will increase the likelihood of overall multitasking. (b) Greater ownership and use of a specific platform will increase the likelihood of the related type of media-multitasking.

Part b of this third hypothesis is a more nuanced and explanatory version of *part a*, yet it has high face validity. For example, greater use of game systems and MP3 players should each increase the likelihood of overall multitasking (*part a*), but more specifically using a *game system* should increase the likelihood of multitasking *while gaming* (*part b*). Likewise, owning and using an *MP3 player* should increase the likelihood of multitasking *while listening to music* (*part b*).

As reviewed above, the evidence from the literature on gender and multitasking suggests the following:

Hypothesis 4. Overall, more girls will multitask than boys.

The linchpin of this paper's new claim involves the combination of the arguments contained in hypotheses 1–3 to explain hypothesis 4. If there are preferences among girls and boys for particular platforms, then this will lead youth to differentially use these technologies. If multitasking is simply a function of technology platform ownership and use as suggested in hypothesis 3, then we deductively combine the previous arguments into the following mediation argument:

Hypothesis 5. (a) Compared to boys, girls are more likely to multitask during communication and music activities, (b) explained by their greater ownership and use of communication- and music-related platforms.

Hypothesis 6. (a) Compared to girls, boys are more likely to multitask during gaming, (b) explained by their greater ownership and use of gaming-related platforms.

3. Methods

3.1. Sample

Data for this study came from a cross-sectional survey administered to a stratified random sample of middle-school students in one mid-Atlantic United States county school system. To enhance racial and socioeconomic heterogeneity four schools in the district were selected according to a stratification of schools based on their percentages of students with free or reduced price lunch. A fifth school with relatively high free and reduced price lunch participation was also surveyed to increase the number of students sampled from low socioeconomic status schools. All students in the first four schools were surveyed, however, only five classes in the fifth school were chosen due to time constraints. Across all schools, the response rate exceeded 99%.

3.2. Measures

3.2.1. Dependent variables

The outcome of interest is whether students multitask when using the computer, measured in two different ways.

General multitasking. The initial outcome variable is a dichotomous choice whether the student does more than one activity on the computer at a time.

Specific media-based multitasking. Students who responded "yes" to the general multitasking question were asked to list all of their other activities that they did when they were on the computer. Using these responses, we created a set of new variables. The lists of multitasking activities were examined for commonalities

and categorized into a concise set of media activity variables by one researcher unaware of our current hypotheses. Unclear cases, of which there were few, were resolved through discussion among three researchers. The eleven emergent categories included *chatting/instant messaging, surfing the web, doing homework, emailing, gaming, listening to/downloading music, social networking, creating web content, using a phone, word processing/writing,* and *other.* If the respondents engaged in any activity in a category, a dichotomous variable for multitasking specific to that category was coded 1. Because some respondents listed multiple activities in the same category (e.g., chatting and instant messaging), our analyses are conservatively biased with regard to the number of categories of multitasking activities, and thus amount of overall multitasking.

3.2.2. Independent variables

Our primary independent variables are self-reported gender, technology platform ownership and time use.

Ownership. For ownership we asked respondents if they owned a desktop computer, laptop computer, iPod, non-iPod MP3 player, cell phone, game system, and other (not listed) technologies. Other technologies were not included in this analysis. We combined iPods and non-iPod MP3 players into one measure of MP3 player ownership.

Hours of Use. We also asked students to write out the number of hours they daily spent using computers (this was not asked separately for desktops and laptops), MP3 players (iPod and non-iPods were combined), cell phones, and game systems. Note that these questions on ownership and usage were asked separately because it is possible to use devices frequently without owning them (e.g., sharing with friends or family or using school or public devices).

3.2.3. Control variables

We asked respondents to rank their computer skill using a scale, ranging from *Not Skilled* (1) to *Expert* (10). Mother's and father's education was measured on a scale ranging from *Less than High School* (1) to *College Degree or Higher* (4). The greater of the father's or mother's education was coded as parental education. School socioeconomic status was coded by school using the percentage of children receiving free or reduced price lunches. Schools with 20% or fewer students on free or reduced price lunch were considered high socioeconomic status and coded as 1, while the others were coded as 0. Other controls were grade in school (6th, 7th, or 8th), and race/ethnicity as a series of dummy variables (White, African-American, Asian, Hispanic, and Other).

3.3. Analysis

If data was missing on any variable (except parental education, see *4.1. Sample* section) we removed that case from our dataset. We used *t*-tests to examine bivariate mean gender differences in technology ownership, use, and types of multitasking. We conducted binary logistic regression analyses to examine the relationships among platform ownership and use, gender, and control variables on multitasking. Due to our repeating analyses on several types of specific multitasking, we inflate our chances of erroneously finding significant results. For all hypothesized results we conducted Bonferroni corrections to account for this. For simplicity of comparison, we report the uncorrected significance level for each analysis in both the tables and text, but note for hypothesized results if the Bonferroni correction changed a result's statistical significance.

4. Results

4.1. Sample

Our sample of 895 students was almost evenly split among boys and girls (49.5% female). The majority of the students were White

Table 1
Bivariate correlations of the dependent variables.

	1	2	3	4	5	6	7	8	9	10	11
1. General multitasking	–										
2. Chat	.519***	–									
3. Content creation	.084*	.014	–								
4. Email	.247***	.184***	.014	–							
5. Gaming	.364***	.148***	−.009	.061	–						
6. Homework	.333***	.159***	−.018	.005	.037	–					
7. Internet	.410***	.252***	.030	.050	−.050	−.050	–				
8. Music	.447***	.071*	−.017	.049	.035	.117***	.144***	–			
9. Social networking sites	.158***	.185***	.098**	.051	.061	.031	−.058	−.039	–		
10. Phone	.094**	−.103**	−.022	−.063	−.060	.003	−.105**	.009	−.010	–	
11. Word processing	.154***	−.008	.068*	.018	−.046	−.050	.123***	.049	−.008	−.039	–

* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p \leqslant .001$.

(53.6%), with less than 15% in any other racial/ethnic category (14.9% Black, 8.7% Hispanic, 11.7% Asian, and 11.1% Other). The respondents were about evenly split across the three grades (4th, 5th, and 6th) with an average age of approximately 12.5. Nearly 58% of the surveyed students were at a school we classified as being a high in socioeconomic status. Slightly over a third of students either did not know or had missing data for one or both of their parents' education; thus, we imputed parents' education from school, grade, gender, and race/ethnicity for the missing and *don't know* cases. After imputation, the median response for parents' education was *college degree or higher* (4 on a scale of 1–4). The mean response for fathers was 3.72, mothers was 3.67, and the mean of parental education was 3.86. Finally, self-reported computer skill of the respondent averaged 7.86 on a scale from 1 to 10. Correlations for multitasking variables are presented in Table 1, with the percentages of multitasking in the sample shown in Table 5. Technology ownership and use was widespread and substantial among the members of this middle school sample, as shown in Table 2.

4.2. Hypothesis 1 and 2 Results: gender use and ownership

For hypotheses 1 and 2 we conducted t-tests to ascertain hours of use and ownership differences between boys and girls. Hypothesis 1 proposed that more girls will own and use communication and music platforms. Sixty percent of girls in this sample owned cell phones compared to only 52.4% of the boys ($t = -2.30$, $p \leqslant .05$, Table 2; hypothesized effects are bolded on the table), and girls used the phone for 1.31 h per day compared to .81 h per day for boys ($t = -4.90$, $p \leqslant .001$). For MP3 players, boys and

Table 2
Technology platform ownership and usage by gender ($n = 895$).

	Boys	Girls	Full sample
	Technology ownership (percent)		
Desktop	93.4	93.2	93.3
Laptop	46.0	49.7	47.8
MP3 player	77.7	74.0	75.9
Cell phone***	52.4	60.0	56.2
Game system***	96.0	81.0	88.6
	Technology usage (hours per day)		
Computer	1.99	2.09	2.04
MP3 player*	1.18	1.43	1.58
Cell phone***	.81	1.31	1.06
Game system***	1.92	.89	1.41

Note: Hypothesized gender differences are in bold.
* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p \leqslant .001$.

Table 3
Binary logistic regression on general multitasking ($n = 895$).

	Odds of multitasking[a]		
	Model 1	Model 2	Model 3
Own platform			
Desktop	**2.018***		**1.806**
Laptop	**1.143**		**1.054**
MP3 player	**1.736***		**1.392**
Cell phone	**1.921****		**1.479***
Game system	**.844**		**1.262**
Hours of use			
Computer		**1.345****	**1.355****
MP3 player		**1.210****	**1.166***
Cell phone		**1.359****	**1.241***
Gaming		**.767****	**.777****

Note: Hypothesized effects are in bold.
* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p \leqslant .001$.
[a] All models control for grade in school, parental education, computer skill, school socioeconomic status, and race\ethnicity.

girls did not significantly differ in ownership (77.7% of boys and 74.0% of girls owned MP3 players, $t = 1.26$, ns); however girls spent 1.43 h per day listening to their MP3 players compared to boys who averaged only 1.18 h per day ($t = -2.40$, $p \leqslant .05$).

Hypotheses 2 stated that more boys use and own gaming platforms. It was supported with 96.0% of boys and 81.0% of girls owning gaming systems ($t = 7.24$, $p \leqslant .001$), and boys spending 1.92 h per day compared to girls spending .89 h per day using their gaming systems ($t = 10.60$, $p \leqslant .001$). We did not hypothesize gender differences in desktop or laptop ownership or time spent using any computer, and in our sample there were no gender differences for these items. Overall, hypotheses 1 and 2 were supported with the exception of owning MP3 players.

4.3. Hypothesis 3 Results: ownership and use's effect on multitasking

Next we investigate hypothesis 3, which states in *part a* that owning and using more platforms in general will increase the likelihood of multitasking. For this we conducted binary logistic regression analyses[1] (Table 3). Model 1 shows that owning desktops, MP3 players, and cell phones increases the odds of multitasking, whereas owning laptops or gaming systems did not affect the odds of multitasking. Model 2 indicates spending more time using the computer, MP3 player, or cell phone increased the odds of

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[1] All binary logistic regression models include the following controls (not shown in tables): grade in school, parental education, student's own computer skill, school socioeconomic status, and race\ethnicity.

Table 4
Binary logistic regression on specific types of multitasking (n = 895).

| | Odds of specific types of multitasking[a] | | | | | | | | | |
	Email	Content creation	Homework	Word processing	Internet	Social networking	Chat	Phone	Music	Gaming
Own platform										
Desktop	**.826**	**.659**	**1.393**	**1.736**	**1.331**	[b]	**1.418**	.292	1.995	**1.327**
Laptop	**.901**	**2.017**	**1.069**	**1.764**	**1.193**	**1.235**	**.990**	2.398	.892	**.910**
MP3 player	.985	1.346	1.182	.847	1.054	1.322	1.364	.668	**1.419**	1.203
Cell phone	.958	.933	1.075	.817	1.308	**2.741**[*]	**1.587**[**]	**.735**	1.182	1.324
Game system	.770	2.317	1.367	**.444**[*]	.806	1.845	1.061	.676	1.239	**1.185**
Hours of use										
Computer	**1.077**	**1.403**[**]	**.926**	**1.259**[**]	**1.145**[**,c]	1.112	**1.159**[**]	.884	1.107	**1.037**
MP3 player	1.038	.915	1.113	1.005	.991	1.041	1.090	.968	**1.233**[***]	1.019
Cell phone	1.040	.863	1.004	.821	1.008	**1.053**	1.112	**1.595**[***]	1.063	.951
Gaming	**.771**[**]	.794	**.787**[***]	.930	.963	.836	**.805**[***]	.686	**.780**[***]	**1.087**

Note: Hypothesized effects are in bold.
[*] p ⩽ .05.
[**] p ⩽ .01.
[***] p ⩽ .001.
[a] All models control for grade in school, parental education, computer skill, school socioeconomic status, and race\ethnicity.
[b] Because only 9% of computer owners and 8.7% of the sample reported using social networking sites, the odds ratio for this cell is inflated and uninterpretable.
[c] This is no longer significant when a Bonferroni correction is applied.

multitasking; however, time using a gaming system decreased the odds of multitasking. Including both ownership and use in the same model indicates hours of use are more predictive of general multitasking than ownership (Model 3). Aside from owning laptops, game systems, and hours spent gaming we find support for hypothesis 3a.

Hypothesis 3b stated that specific platform use and ownership will affect the related type of media-multitasking. In other words we predict that greater *computer* use and ownership will increase the odds of multitasking during those activities most related to computer ownership and use: chat, content creation, email, homework, Internet, social networks, gaming, and word processing. Ownership and use of *MP3 players* should increase the likelihood of music multitasking, while ownership and use of *game systems* should increase the likelihood of gaming multitasking. Finally, ownership and use of *cell phones* should increase the likelihood of multitasking with the phone, chat, and social networking.

We analyzed binary logistic regression models for the likelihood of each type of media multitasking (Table 4). Computer or laptop ownership did not alter the odds of any type of multitasking, but hours using a computer increased multitasking odds for content creation, word processing, and chat. Owning a cell phone increased the odds of multitasking during social networking and chat, and the number of hours using a cell phone increased the likelihood of phone multitasking. The number of hours of MP3 player use increased the odds of music multitasking. Neither owning a game system nor hours gaming significantly affected the likelihood of gaming multitasking. An interesting pattern present in these analyses is that hours spent gaming decreased the likelihood of multitasking for several of the multitasking activities, similar to the effects for the general measure of multitasking.

4.4. Hypotheses 4, 5 and 6 Results: gender's relationship to multitasking

Now, we consider the relationship of gender to multitasking. Hypothesis 4 proposed that more girls than boys would multitask, and this is supported with 80.8% of girls reporting multitasking compared to only 65.5% of boys (p ⩽ .001; Table 5).

Hypothesis 5 proposed that (a) girls have a higher likelihood of communication and music multitasking, (b) explained by their greater ownership and use of the related platforms. *Part a* was supported for three of the four forms of communication multitasking – chat, email, and phone, but not social networking – and for music multitasking (Table 5). To see if these gender differences can be ex-

Table 5
Gender, and general and specific types of multitasking (n = 895).

| Activity | Percent | | |
	Boys	Girls	Full sample
General multitasking[***]	65.5	80.8	73.9
Chat[***]	36.1	48.5	42.2
Content creation	1.1	2.7	1.9
Email[***]	7.7	20.8	14.2
Gaming	29.0	23.9	26.5
Homework[***]	17.9	28.4	23.1
Internet[**]	27.2	35.4	31.3
Music[**]	30.3	40.2	35.2
Social networking sites	5.1	7.7	6.4
Phone[*]	1.1	3.6	2.3
Word processing[**]	3.5	8.6	6.0
Other	8.0	9.7	8.8

Note: Hypothesized effects are in bold. Mean difference between boys and girls statistically significant at:
[*] p ⩽ .05.
[**] p ⩽ .01.
[***] p ⩽ .001.

plained by ownership and use of technology platforms, we conducted binary logistic regression (Table 6) on all four communication activities (email, social networking, chat, and phone) and the one music activity.[2] In the first model, we regressed the specific type of media multitasking on gender and the control variables. This model indicated gender's effect on the likelihood of specific multitasking and we expected the findings to be congruent with the gender *t*-tests. In a second model, we added platform ownership and use. If part *b* of hypothesis 5 is supported then there will be a reduction in the gender coefficient. If technology ownership and use fully explain the likelihood of multitasking, then the coefficient will no longer be significant. If they partially explain the likelihood of multitasking, then the coefficient may still be significant but have a reduced odds ratio.

Social networking multitasking – which did not significantly differ by gender according to the t-test – had no significant effects in model 1 or 2 (Table 6). Likewise, there were no gender effects for phone multitasking, possibly due to the low percentages reporting multitasking while taking on the phone. Turning to the other activities, girls, compared to boys, were significantly more likely to

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[2] Supplemental Table A in the online supplement includes the same analyses as Table 6 for the non-hypothesized specific types of media multitasking.

Table 6
Binary logistic regression on specific types of multitasking based on gender (*n* = 895).

	Odds of specific type of multitasking[a]											
	Email		Social networking		Chat		Phone		Music		Gaming	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Gender (Female)	**3.240******	2.883***	**1.709**	1.483	**1.785*****	1.403*,c	**3.563***,c	1.948	**1.672*****	1.313	**.780**	.842
Own platform												
Desktop		.867		b		1.449		.308		2.023		1.317
Laptop		.867		1.211		.978		2.365		.882		.914
MP3 player		1.088		1.382		1.409		.712		1.462		1.181
Cell phone		.923		2.680*		1.580**		.723		1.177		1.328
Game system		.912		1.960		1.141		.740		1.308		1.144
Hours of use												
Computer		1.076		1.110		1.154**		.870		1.105		1.039
MP3 player		1.010		1.028		1.078		.957		1.222***		1.024
Cell phone		.991		1.040		1.091		1.564***		1.048		.961
Gaming		.875		.877		.839		.744		.807***		1.066

Note: Hypothesized effects are in bold.
* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p \leqslant .001$.
[a] All models control for grade in school, parental education, computer skill, school socioeconomic status, and race\ethnicity.
[b] Because only 9% of computer owners and 8.7% of the sample reported using social networking sites, the odds ratio for this cell is inflated and uninterpretable.
[c] This is no longer significant when a Bonferroni correction is applied.

multitask while chatting, emailing, and listening to music (Model 1). When including platform use and ownership in model 2, the effect size of gender was reduced for all three specific activities; however chat and email multitasking remained significant. Girls' odds were 1.79 times that of boys for multitasking while chatting, but only 1.40 times greater when controlling for platform ownership and use. Girls' odds for email multitasking were 3.24 times that of boys, reduced to 2.88 by the ownership and use control variables. Girls' odds were 1.67 times greater than boys for multitasking with music, but after controlling for platform ownership and use their odds were no longer significantly different than boys' odds.

Hypothesis 6 states that (a) boys have a higher likelihood of gaming multitasking, (b) explained by greater ownership and use of gaming platforms. For *part a*, we examine the *t*-test presented in Table 5 which indicates that boys do not have greater odds of gaming multitasking compared to girls. Turning to *part b*, we also find no support. Although the odds ratios are in the correct direction, model 1 (Table 6) for gaming multitasking does not indicate a significant gender difference. Because model 2 cannot reduce a gender effect that is not present in model 1, hypothesis 6 is not supported.

5. Discussion

Our first two hypotheses considered the link between gender and technology ownership and use. All these hypotheses were supported except gender differences in MP3 player ownership. The results indicate that more boys owned and used gaming systems whereas more girls owned and used cell phones and used MP3 players. These patterns are consistent with prior research, including some inconsistent findings for gender differences in music player use and ownership (Foehr, 2006; Rideout et al., 2010; Roberts & Foehr, 2008).

Our second set of hypotheses considered the relationship between owning and using technology and media multitasking behaviors. Owning and using most technologies increased the likelihood of general multitasking, although time spent gaming decreased it. There was mixed support for specific media multitasking, with either ownership or use increasing it for seven activities yet having no influence on the other three. Again, the

most striking deviation was that nothing increased the likelihood of gaming multitasking, including using or owning the platforms for games (gaming systems and computers). We cautiously conclude that platform ownership and use in general tends to increase the prevalence of multitasking, excluding gaming.

Our final set of hypotheses proposed that gender differences in likelihood of multitasking with communication, music, and gaming media could be explained by considering gender differences in platform ownership and use. We found the presence of gender differences in the likelihood of multitasking while chatting, emailing, using the phone, and listening to/downloading music. Chatting, emailing, and listening to music were partially or fully accounted for by the technology ownership and use, reducing or eliminating the gender coefficient. Social networking, talking on the phone, and gaming, however, did not show this pattern, and so we address each individually. Considering the low percentages reporting multitasking while on the phone, we feel that we cannot definitively conclude anything about platform ownership and phone multitasking from this dataset. However, the lack of support for social networking and gaming multitasking may be based more on the characteristics of each type of media.

Social networking is an interesting case, and we believe there may be two issues affecting social networking. First, social networking is not exclusively used for communication, and its communication elements are not exclusively one-to-one direct communications. Youth engage with social networking sites not only to communicate directly but also to observe the lives of others (Pempek, Yermolayeva, & Calvert, 2009). A second issue stems from the number of gaming, music, and video applications available for social networking sites. In this way social networking sites function more like platforms than specific applications.

Our results also indicated that certain types of technology use seem to be less compatible with multitasking. Gaming, which can require a great deal of attention (Brown & Cairns, 2004; McGonigal, 2011), was generally associated with a reduction in the overall odds of multitasking. In several analyses, owning or using a gaming platform decreased the odds of general or specific multitasking. Most surprisingly, owning and using those gaming platforms did not affect gaming multitasking. While there were gender differences in gaming ownership and use, these did not impact the likelihood of gaming multitasking. The immersive nature of many video games, especially the multiplayer action games fa-

vored by boys, requires a high level of constant attention and concentration (Cragg, Taylor, & Toombs, 2007; Nacke & Lindley, 2008) as well as both hands and may limit the other types of activities in which one may engage. Aside from in-game chatting, it may be difficult if not impossible to compose an email, do homework, or browse social networking sites while trying to remain alive in a real time action game against unpredictable human and/or virtual opponents. Future work should tease apart the gendered differences in gaming and other media multitasking by considering the cognitive, cultural, and social mechanisms that may affect boys and girls differently.

We found, as expected from previous multitasking research (Foehr, 2006; Jeong & Fishbein, 2007), that more girls than boys report multitasking and that multitasking is gendered by media activity. Our findings are generally consistent with previous findings of greater use of communicative technologies by females and greater use of gaming technologies by males (Cherney & London, 2006; Schumacher & Morahan-Martin, 2001; Selwyn, 2007). Unlike gaming, the nature of activities such as typing, doing homework, emailing, or listening to music are conducive, if not to true multitasking, then at least to *continuous partial attention* (Small & Vorgan, 2008).

5.1. Limitations and future research

While interpreting the results one must keep in mind that they are derived from self-reports of activities the students engage in while they are on the computer. Furthermore, the multitasking variables were derived from a dichotomous choice question and list of activities. Not including more nuanced measures of levels of multitasking is a limitation, yet not forcing students to choose from predefined categories for multitasking is a strength of this research in that it allows students to indicate their own categories. In future studies, having computer log usage and time diary data would allow for more accurate reporting of the specific activities and amounts of time in which they were engaged in these activities (e.g., Judd, 2013).

In addition, we know little about the reasons for multitasking among these students. Further research that involves both qualitative and quantitative data collection efforts could help to better ascertain the specific amounts, types, and functions of multitasking among this age group. Research indicates that boys and girls engage with technology for different reasons and goals (Lucas and Sherry, 2004), which no doubt affects their styles and forms of multitasking. Another issue is that our sample includes cross-sectional data from one school system, limiting the generalizability of our findings. We only included one school-level variable and did not analyze multiple levels; however an expansion of school-level properties could be a promising way to discriminate between local differences in multitasking and more robust, generalizable findings. Our goal, however, was not to generalize on a representative sample, but focus on the relationships between technologies, multitasking, and gender. Building on the literature we considered how technology ownership and use could mediate, and thus provide a partial explanation of the observed relationship between gender and technology-based multitasking. Future research should consider the possibility of a moderating relationship, whereby gender enhances the effect of ownership and use on specific types of multitasking. A supplemental analysis suggests there would be several gender and technology interaction effects on specific types of multitasking.[3] A full consideration of moderating effects would also help explain if boys' and girls' different cultures of technology

or their different cognitive abilities lead them to different styles of media multitasking.

For future research, one area of particular interest is whether actual multitasking is occurring or if, instead, youth are engaging in what Small and Vorgan (2008) term *continuous partial attention*. In continuous partial attention, rather than being actively engaged, the individual is "keeping tabs" on all the different media, monitoring each for changes and updates and giving attention where necessary. Our brains are not structured to handle such engagement effectively for long periods of time (Small & Vorgan, 2008). Another interesting line of research would be to uncover to what degree youth are engaging in self-induced multitasking, choosing to multitask without being prompted by an external interruption, which can lead to degradations in performance and concentration (Adler & Benbunan-Fich, 2013). Both continuous partial attention and self-induced multitasking could be troublesome given that 207 students in our sample reported homework as one of their multitasking activities and recent research suggests that youth who multitask while studying achieve lower grades (Karpinski et al., 2012; Rosen et al., 2013; Sana et al., 2013).

Another area for future research is an examination of the effects of multitasking on digital natives as they age and progress through the life course and when and how gender differences in multitasking change. Research suggests that there are few, if any, gender differences in the *ability* to multitask (Klingberg, 2008); however, more research is required on how gender structures the expectations, experiences, and practice of multitasking.

6. Conclusion

Our sample indicates that multitasking is common among both middle school boys and girls; however, there are significant gender differences in multitasking with specific types of media activities. We considered ownership and time use of various technologies and how engagement with those technological platforms should increase multitasking. Based on those patterns we proposed our argument: that the relationship of owning and using technology would explain the gender differences in multitasking. Overall, we found support for this explanation for both music and communication multitasking, suggesting a new avenue for future theorizing about inequalities in media multitasking.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.chb.2014.02.041.

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[3] MP3 Ownership × Female increased email multitasking (Odds 5.313, $p \leqslant .01$); Cell Phone Ownership × Female increased chat multitasking (Odds 2.113, $p \leqslant .05$); and Laptop Ownership × Female decreased gaming multitasking (Odds .526, $p \leqslant .05$).

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