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When does multitasking facilitate information processing? Effects of Internet-based multitasking on information seeking and information gain

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Abstract This study examined whether Internet-based multitasking facilitates information gain by allowing users to seek additional information online. Study 1, using survey data, suggested that TV-Internet multitasking increased information gain, whereas TV-print media multitasking reduced it. In addition, online information seeking mediated the effect of TV-Internet multitasking on information gain. Study 2, using experimental data, confirmed the differential effects of TV-Internet multitasking and TV-print multitasking on information gain. The theoretical and practical implications of these findings are further discussed.

Keywords Internet · Multitasking · Information seeking · Information gain

Introduction

Media users frequently engage in multitasking by combining one medium with other media (Foehr 2006; Holmes et al. 2006; Pilotta and Schultz 2005). For example, Holmes et al. (2006) surveyed media users in the US and found that only 41 % of the total amount of time Internet users spent on the Internet was devoted to single medium use (Internet only), whereas 59 % of their time was spent multitasking. For television viewing, 54 % of the total television time was spent using that medium only, whereas 46 % was spent multitasking, and for print media use, 60 % of the total time was spent using print media only, whereas 40 % was spent multitasking.

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A large body of experimental research on multitasking has found that multitasking inhibits information processing (e.g., Armstrong and Chung 2000; Armstrong and Greenberg 1990; Armstrong and Sopory 1997; Beentjes et al. 1996; Pool et al. 2000, 2003). On the other hand, survey research on multitasking found that multitasking can increase media effects (Collins 2008).

Although most types of multitasking may reduce media effects by inhibiting information processing, some types of multitasking may increase media effects by facilitating information processing. Specifically, multitasking involving the Internet (e.g., TV-Internet multitasking) may increase media effects by allowing individuals to seek additional information. When individuals receive information from TV or newspapers, they may seek additional information if they have access to the Internet. Based on survey and experimental data, the present study tests whether multitasking that involves traditional media only (e.g., TV-print media) and multitasking that involves new media (e.g., TV-Internet) have differential effects on consumers' information gain.

Multitasking and information processing

Multitasking with traditional media

The role of multitasking in information processing has been explained based on the limited capacity model of information processing (Kahneman 1973; Lang 2000). The model suggests individuals have a limited set of cognitive resources, which need to be allocated to multiple media sources when media users multitask. Previous research on multitasking has found that individuals recall and comprehend less information and perform poorly on cognitive tasks when they multitask (Armstrong and Chung 2000; Armstrong and Greenberg 1990; Armstrong and Sopory 1997; Beentjes et al. 1996; Pool et al. 2000, 2003). When individuals multitask while they use a medium (e.g., print media), the amount of information they gain from the medium is likely to be reduced compared to when they focus on the medium only.

Multitasking with the Internet

Some forms of multitasking, however, may increase information gain, particularly when individuals seek additional information while multitasking. This is likely when individuals engage in a type of multitasking involving the Internet. Internet-based multitasking can facilitate information gain due to the characteristics of Internet media, including interactivity. The Internet allows the user to conduct an online search in which an individual types a query into a search engine to obtain a search results list relevant to the query (Cole 2011).

Simultaneous exposure to the Internet and other mass media sources, such as television, may enhance online information search, and this could be explained based on the agenda-setting effect of mass media. According to agenda-setting theory (McCombs and Shaw 1972), the media can influence the public's agenda, or issues that the public perceive to be important. Research suggests that the media (e.g., television) may not only affect the public's agenda, but also their information seeking behavior. For example, Weeks and Southwell (2010) found that mass media news coverage of the rumor that Obama was secretly Muslim increased the public's online search regarding the topic.

Collins (2008) has suggested that TV-Internet multitasking can amplify the effect of television content on its viewers. In her longitudinal study, Collins suggested that exposure

to sexual content on TV increases adolescent sexual behavior, and that this effect was greater among heavy TV-Internet multitaskers than among light multitaskers. She explained that this may be because heavy TV-Internet multitaskers tend to seek additional sexual content online when they view such content on TV.

Although not specifically focusing on multitasking, Beaudoin (2008) provided some evidence for the differential effects of TV-Internet news use and TV-print media news use on information gain. For knowledge about international issues, he found (a) a positive interaction effect of Internet news use and TV news use on knowledge gain and (b) a negative interaction effect of newspaper news use and TV news use on knowledge gain. More specifically, respondents who consumed TV news in conjunction with Internet news gained more knowledge about international issues, whereas those who consumed TV news in conjunction with print news acquired less knowledge. Although Beaudoin did not directly test the effects of multitasking, he suggested that these two types of media combination may be qualitatively different and that they may have differential effects on knowledge gain. When audiences are exposed to television news, they may want to learn more about some topics, and the Internet allows users to search additional information. Thus, multitasking behaviors that involve the Internet may facilitate knowledge gain.

Given that previous studies have not directly compared the effects of different forms of multitasking, the present study compares the effects of TV-Internet and TV-print media multitasking on information gain. This is because, although there are various types of multitasking, the most frequently performed types are TV-Internet and TV-print media multitasking (Foehr 2006; Holmes et al. 2006; Pilotta and Schultz 2005). To compare the effects of TV-Internet and TV-print media multitasking, we conducted two studies. Study 1 used survey method to assess the effects of different types of multitasking on information gain in a natural setting. Study 2 employed experiment method to confirm whether findings reported in Study 1 can be found in a more controlled setting.

Study 1

For Internet-based multitasking, the effect of using traditional media (e.g., TV) on information gain is more likely to increase (because of additional information seeking) than to decrease (because of limited capacity). Thus, this study hypothesizes that TV-Internet multitasking will have positive effects on information gain, whereas TV-print media multitasking will have negative effects on information gain, when the level of advertising exposure is controlled (Table 1).

In addition, this research examines the effects of media ownership on TV-Internet multitasking, because previous research has shown that having private access to media increases the amount of time spent on media multitasking (Jeong and Fishbein 2007; Roberts et al. 2005). We considered two types of media ownership relevant to Internet-based multitasking:

Table 1 Definitions of key variables in this study

Variables	Definition
TV-Internet multitasking	Using the Internet while watching TV
TV-Print media multitasking	Reading print media while watching TV
Online information seeking	Searching for information on the Internet
Information gain	Retaining information provided in media messages

computer ownership and smartphone ownership. We selected these because television viewers can access the Internet using computers or smartphones. Although Korea ranked as one of the highest nations in terms of Internet and mobile phone penetration rates (International Telecommunication Union 2009), not all Koreans have an Internet-enabled computer and a TV in their bedroom or study, and not all Koreans own a smartphone.

We, therefore, propose the following hypotheses:

H1: Computer ownership and smartphone ownership will be positively related to TV-Internet multitasking after controlling for demographic variables (age, gender, education, and income).

H2: After controlling for background characteristics (demographic variables, media ownership, and advertising exposure), TV-Internet multitasking will be positively related to information gain, whereas TV-print media multitasking will be negatively related to information gain. That is, the more one engages in TV-Internet multitasking, the higher one's level of information gain, whereas the more one engages in TV-print media multitasking, the lower one's level of information gain.

The role of information seeking

The positive effect of Internet-based multitasking on information gain is likely to be mediated by information seeking or search behaviors (Fig. 1). Online information seeking or search is important because it may lead to information gain (Kitchens et al. 2003; Shim 2008; Shim et al. 2006). For example, Shim et al. (2006) found that those who sought more information about cancer on the Internet had a higher level of knowledge about cancer.

Information seeking or search behavior may be increased when media users engage in Internet-based multitasking. For example, Zigmond and Stipp (2010) found that search queries for new cars (e.g., Chevrolet Volt and Nissan Leaf) or a new film (e.g., Night at the Museum 2) increased when a commercial for the product was shown on television. They explained that this may be because television viewers sought additional information about the product on the Internet while they were multitasking (p. 167). However, the researchers did not directly test the relationship between multitasking and information search.

Given that Internet-based multitasking may facilitate additional information seeking and that information seeking may enhance information gain, it is reasonable to expect that Internet-based multitasking will lead to information gain. Thus, the present study proposes the following hypothesis:

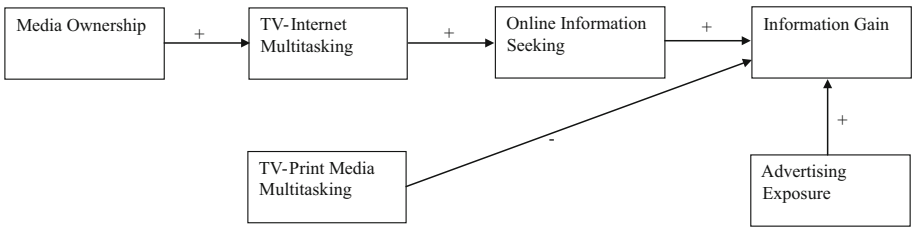

Fig. 1 Conceptual model for Study 1

H3: Online information seeking will mediate the relationship between TV-Internet multitasking and information gain. More specifically, individuals who engage in TV-Internet multitasking will be more likely to search for information online and thus gain more information than those who do not.

Method

Participants

We conducted an online survey of 1,121 adults in Korea. We recruited the respondents based on a panel maintained by an online survey firm, EZ Embrain Survey. The respondents' ages ranged from 19 to 59, and the mean age was 38.38 (SD = 10.91). In addition, 50.3 % (564) of the respondents were male. In terms of education, 21 % had a high school degree or less; 16 % had a 2-year college degree; 53 % had a bachelor's degree; and 9 % had a postgraduate degree. The median annual household income was approximately 50 million Korean won.

Measures

Following previous studies employing a self-reported measure of the amount of time spent on multitasking (Holmes et al. 2006), we assessed *TV-Internet multitasking* by asking the respondents to report the amount of time they spent on TV-Internet multitasking per day in minutes. The amount of time spent on TV-Internet multitasking ranged from zero (= 0) to 780 min ($M = 50.28$, SD = 82.91) per day.

We measured *TV-print media multitasking* by asking the respondents to report the amount of time they spent on TV-print media multitasking per day. The amount of time spent on TV-print media multitasking ranged from zero (= 0) to 600 min ($M = 25.48$, SD = 46.81) per day.

We measured *online information seeking* by asking the respondents to report how often they typically searched the Internet to obtain more information on what they saw on TV. The response options were *never* (1), *rarely* (2), *sometimes* (3), *often* (4), and *very often* (5). The mean level of information seeking was 3.42 (SD = 0.98).

We measured *information gain* by the respondent's recall of information provided in advertising messages. For these messages, we selected (1) Samsung's Smart TV, (2) LG's 3D (three-dimensional) TV, and (3) SK Telecom's 4G LTE (fourth-generation long-term evolution) network services. We selected these items because they represented new product categories, and we expected some variation in consumers' knowledge about the items. The Smart TV advertisement explained that the product is an interactive TV allowing the viewer to communicate with others; the 3D TV advertisement showed that the product provides a more exciting viewing experience with more vivid images; and the 4G LTE advertisement stated that the service provides faster transmission speeds for downloading and uploading content using mobile phones.

To measure the respondent's recall of information provided in advertising messages, we asked the following: "In the Samsung Smart TV advertisement, which of the following characteristics is mentioned as a benefit of the product?" The correct (= 1) response was "the ability to communicate," whereas the incorrect (= 0) responses were "faster transmission speeds," "better sound quality," and "don't know." We employed the same

method for the 3D TV and the 4G LTE service. The correct responses for the LG 3D TV and the 4G LTE service were "vivid images" and "faster speeds," respectively. We computed the score for information gain by determining the total number of accurate responses to the three items. The scores ranged from 0 to 3 ($M = 2.20$, SD = 0.89).

In addition to the demographic characteristics, we measured exposure to advertising messages and media ownership. We measured *advertising exposure* by asking the respondents to report how often they viewed each of the three advertisements. The response options were *never* (1), *rarely* (2), *sometimes* (3), *often* (4), and *very often* (5). The average level of exposure was 3.86 (SD = 0.79). In addition, we measured Internet-relevant *media ownership* using the following two items: "Do you have a television and a computer with Internet access in the same room at home?" (computer ownership) and "Do you have a smartphone with Internet access?" (smartphone ownership). In terms of media ownership, 77 % of the respondents reported that they had a television, as well as a computer with Internet access in the same room at home, and 63 % reported that they had a smartphone.

Results

Correlational analyses represented in Table 2 show that information gain is correlated with age ($r = -0.13$, $p < 0.001$), education ($r = 0.07$, $p < 0.05$), income ($r = 0.08$, $p < 0.05$), advertising exposure ($r = 0.32$, $p < 0.001$), smartphone ownership ($r = 0.15$, $p < 0.001$), TV-Internet multitasking ($r = 0.07$, $p < 0.05$), and online information search ($r = 0.17$, $p < 0.001$).

H1 predicted that ownership of media that enabled Internet access (computer ownership and smartphone ownership) would be positively related to TV-Internet multitasking. Consistent with the prediction, computer ownership ($B = 27.08$, SE = 5.80, $\beta = 0.14$, $p < 0.001$) and smartphone ownership ($B = 11.56$, SE = 5.34, $\beta = 0.07$, $p < 0.05$) were positive predictors of TV-Internet multitasking when demographic variables were controlled for. Thus, H1 was supported.

H2 predicted that information gain would be positively related to TV-Internet multitasking but negatively related to TV-print media multitasking. As presented in Table 3, the results showed that TV-Internet multitasking was a positive predictor of information gain ($B = 0.001$, SE = 0.00, $\beta = 0.08$, $p < 0.01$), whereas TV-print media multitasking was a negative predictor ($B = -0.001$, SE = 0.00, $\beta = -0.07$, $p < 0.05$). Thus, H2 was supported. In addition, online information gain was predicted by age ($B = -0.01$, SE = 0.00, $\beta = -0.08$, $p < 0.05$), income ($B = 0.03$, SE = 0.01, $\beta = 0.08$, $p < 0.01$), advertising exposure ($B = 0.35$, SE = 0.03, $\beta = 0.31$, $p < 0.001$), and smartphone ownership ($B = 0.16$, SE = 0.06, $\beta = 0.09$, $p < 0.01$) Respondents who were younger, more frequently exposed to advertising, had a higher level of income, or had a smartphone gained more information.

H3 predicted that online information search would mediate the relationship between TV-Internet multitasking and information gain. The results show that the significant effects of TV-Internet multitasking on information gain ($B = 0.001$, SE = 0.00, $\beta = 0.08$, $p < 0.01$) decreased ($B = 0.001$, SE = 0.00, $\beta = 0.07$, $p < 0.05$), when online information search was included in the model, which indicates partial mediation. In addition, TV-Internet multitasking increased online information search ($B = 0.001$, SE = 0.00, $\beta = 0.10$, $p < 0.01$), which in turn increased information gain ($B = 0.09$, SE = 0.03,

Table 2 Zero-order correlations between variables in Study 1

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Age	–										
2. Female	−0.06	–									
3. Education	−0.15***	−0.22***	–								
4. Income	0.12***	−0.07*	0.22***	–							
5. Advertising exposure	−0.07*	−0.03	0.00	−0.01	–						
6. Computer ownership	0.12***	−0.05	0.04	0.04	0.08*	–					
7. Smartphone ownership	−0.28***	−0.13***	0.13***	0.11***	0.07*	0.05	–				
8. TV-Internet multitasking	−0.09**	0.12***	−0.07*	−0.07*	0.03	0.12***	0.07*	–			
9. TV-Print media multitasking	0.05	0.16***	−0.10**	−0.03	0.01	0.07*	−0.02	0.36***	–		
10. Online information seeking	−0.18***	0.02	0.08**	−0.01	0.16***	0.10***	0.17***	0.16***	0.09**	–	
11. Information gain	−0.13***	−0.06	0.07*	0.08*	0.32***	0.00	0.15***	0.07*	−0.05	0.17***	–
Mean	38.38	0.50	5.50	4.92	3.86	0.77	0.63	50.28	25.48	3.42	2.20
SD	10.91	0.50	0.95	2.15	0.79	0.42	0.48	82.91	46.81	0.98	0.89

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 3 Regression results for online information seeking and information gain (Study 1)

	TV-Internet multitasking		Information seeking		Information gain		Information gain	
	B (SE)	*β*	*B* (SE)	*β*	*B* (SE)	*β*	*B* (SE)	*β*
Age	−0.62 (0.24)	−0.08*	−0.01 (0.00)	−0.14***	−0.01 (0.00)	−0.08*	−0.01 (0.00)	−0.06*
Female	19.28 (5.03)	0.12***	0.04 (0.06)	0.02	−0.06 (0.05)	−0.03	−0.06 (0.05)	−0.04
Education	−5.04 (2.75)	−0.06	0.06 (0.03)	0.06	0.02 (0.03)	0.02	0.02 (0.03)	0.02
Income	−1.99 (1.18)	−0.05	−0.01 (0.01)	−0.01	0.03 (0.01)	0.08**	0.03 (0.01)	0.08**
Computer ownership	27.08 (5.80)	0.14***	0.19 (0.07)	0.08**	−0.06 (0.06)	−0.03	−0.08 (0.06)	−0.04
Smartphone ownership	11.56 (5.34)	0.07*	0.21 (0.06)	0.11***	0.16 (0.06)	0.09**	0.14 (0.06)	0.08*
Advertising exposure			0.17 (0.04)	0.13***	0.35 (0.03)	0.31***	0.34 (0.03)	0.30***
TV-Internet			0.001 (0.00)	0.10**	0.001 (0.00)	0.08**	0.001 (0.00)	0.07*
TV-print media			0.001 (0.00)	0.06	−0.001 (0.00)	−0.07*	−0.001 (0.00)	−0.07*
Online information seeking			–	–	–	–	0.09 (0.03)	0.10***
Total R^2 (%)	0.05		9.8		14.0		15.0	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

$\beta = 0.10$, $p < 0.001$), indicating indirect effects. The results of the Sobel test indicated that the mediation effect is significant ($z = 2.02$, $p < 0.05$). Thus, H3 was supported.

Discussion

As expected, the results suggest that Internet-based multitasking (i.e., TV-Internet multitasking) was positively related to information gain, whereas TV-print media multitasking was negatively related to information gain. This may be because when individuals engage in Internet-based multitasking, they may seek additional information online, which may facilitate media-based learning. On the other hand, multitasking that combines two or more traditional media may limit information processing, which can interfere with learning.

Although Study 1 presents evidence that Internet-based multitasking plays a facilitating role in information gain, it has an important limitation. Although the study was conducted in a natural setting and accordingly has high external validity or generalizability, there is a threat to internal validity due to potential confounding variables. Although we controlled for confounding variables such as demographics and media ownership, there could be additional confounders that were not measured. An experiment could eliminate the effects of confounding variables based on random assignment to conditions. Thus, an experimental study was conducted in Study 2.

Study 2

We conducted an experiment to compare the effects of TV-Internet multitasking and TV-print multitasking on information gain. In the experiment, the participants were assigned to conditions in which they (a) used the Internet, while watching TV content or (b) read a printed message, while watching the same TV content. Thus, for Study 2, we propose the following hypothesis:

H4: When viewing television, the television-Internet multitasking group will gain more information about television content than the television-print multitasking group.

Method

Participants

We employed a convenience sample of 98 adults residing in Seoul, Korea. We recruited the participants through flyers posted in community centers near the university where the study was conducted. Each participant received 10,000 Korean won for their time. The mean age of the participants was 38.45 (SD = 5.85), and 71.4 % were female. In addition, 15.5 % had a high school degree; 11.3 % had a 2-year community college degree; and 73.2 % had a bachelor's degree. The median annual household income was approximately 54 million Korean won.

Design

We employed a two-group experimental design in which the participants were randomly assigned to one of the following two conditions: the TV-Internet multitasking group ($n = 52$) or the TV-print media group ($n = 46$).

Experimental procedure

We invited each participant to a computer lab at a university. We asked the participants in both groups to watch two short television news messages about Hepatitis C and property accumulation savings for about 5 min. We chose the two messages because they provided new information. Hepatitis C is less common than Hepatitis A or B, and property accumulation savings were a new type of financial service introduced in the Korean financial market in March 2013. Thus, we expected the participants to have little prior knowledge about the two topics.

The TV-Internet multitasking group was allowed to use the Internet while viewing the television messages. Specifically, Naver (www.naver.com) was made available to them so that they could search for information while viewing the television content. On the other hand, the TV-print media group was instructed to read a printed version of pages from Naver to ensure that the multitasking content was comparable across the two experimental groups. We did not direct the participants in the TV-Internet-multitasking group to search for information on the two topics. Instead, to simulate a more realistic multitasking environment, we instructed them to use the Internet freely if they wanted to.

Messages

The Hepatitis C message contained a brief description of Hepatitis C, specifically the prevalence, symptoms, consequences, and causes. The property accumulation savings message provided some information on the new financial service. Specifically, the message described that the savings rate had reduced recently, and the new service would be introduced in the market to stimulate savings.

After the participants completed viewing the television content, the experimenter collected the printed messages (for the TV-print media multitasking group) or turned off the computer (for the TV-Internet multitasking group). Then, the participants completed a questionnaire. The participants were unable to refer the Internet to answer the questions.

Measures

For *information gain*, we used a series of questions that assessed participants' knowledge about Hepatitis C and property accumulation savings. For Hepatitis C, the following questions were used: (1) "Hepatitis C is caused by viral infection," (2) "There is a vaccine to prevent Hepatitis C," (3) "There are more cases of liver diseases due to Hepatitis C than those due to Hepatitis B," (4) "Hepatitis C is transmitted by blood transfusion," and (5) "Hepatitis C is transmitted by shaking hands or kissing."

We assessed property accumulation savings knowledge using the following five items: (1) "Property accumulation savings are not subject to tax," (2) "Employees whose annual income is lower than 35 million won can open the property accumulation savings account," (3) "Owners of small businesses who make less than 50 million won can open the property accumulation savings account," (4) "One can deposit up to 20 million won (or

18,000 USD) per year using property accumulation savings account," and (5) "The annual interest rates for the property accumulation account are expected to be around 4 %."

For all items, we asked the participants to answer *yes* or *no* or *don't know*. We coded the answer for each item as correct or incorrect; "don't know" was considered incorrect. We then computed the total scores by averaging the scores for each topic. The average total score was 0.45 (SD = 0.20). For Hepatitis C knowledge, the average total score was 0.46 (SD = 0.24), and for property accumulation savings knowledge, it was 0.44 (SD = 0.29).

In addition, to assess whether a study participant actually engaged in online search, we asked study participants in the TV-Internet multitasking group to report whether they searched for information about (a) Hepatitis C and (b) property accumulating savings on the Internet. Response options were yes or no.

We also asked the participants' age, gender, education, and income and found no significant differences across the two conditions in terms of these background characteristics. Thus, randomization was successful.

Results

H4 predicted that the TV-Internet multitasking group would demonstrate a higher level of information gain than the TV-print media multitasking group. The results of a repeated-measure ANOVA were conducted, including multitasking type as a between-group factor, and topic (i.e., Hepatitis C and property accumulation savings) as a within-group factor. The results showed a significant effect of multitasking type on information gain (F (1, 96) = 9.48, $p < 0.01$), but the effect of topic (F (1, 96) = 0.14, $p = 0.71$) and the interaction effect between multitasking type and topic (F (1, 96) = 2.26, $p = 0.14$) were not significant (Table 4).

Regardless of topic, the TV-Internet multitasking group (Hepatitis C: $M = 0.54$, SD = 0.25; property accumulation savings: $M = 0.48$, SD = 0.27) demonstrated a higher level of information gain than the TV-print media multitasking group (Hepatitis C: $M = 0.37$, SD = 0.21; property accumulation savings: $M = 0.41$, SD = 0.30). The results showed that TV-Internet multitasking resulted in greater information gain than TV-print media multitasking, which supports H4.

A closer examination indicated that 63 % of the respondents in the TV-Internet multitasking group searched for information about Hepatitis C and 42 % of the respondents searched for information about property accumulation savings on the Internet. Descriptive statistics indicated that the respondents who were in the TV-Internet multitasking group and searched for information showed a higher level of information gain (Hepatitis C: $M = 0.58$, SD = 0.25, $n = 33$; property accumulation savings: $M = 0.54$, SD = 0.26, $n = 22$) than (a) those in the TV-Internet multitasking group who did not search for information (Hepatitis C: $M = 0.48$, SD = 0.23, $n = 19$; property accumulation savings:

Table 4 ANOVA results for Study 2

	df	F	η_p^2	p
Multitasking type	1	9.48	0.09	0.003
Topic	1	0.14	0.001	0.71
Multitasking type ×topic	1	2.26	0.02	0.14
Error	96			

$M = 0.43$, SD $= 0.28$, $n = 30$) and (b) those in the TV-print media multitasking group (Hepatitis C: $M = 0.37$, SD $= 0.21$; property accumulation savings: $M = 0.41$, SD $= 0.30$).

Discussion

In Study 2, the TV-Internet multitasking group showed a greater level of information gain than the TV-print media multitasking group. The results suggest that the differential effects of TV-Internet and TV-print media multitasking found in a natural setting (Study 1) can also be found in a more controlled setting, which altogether supports the idea that TV-Internet multitasking has positive effects on information gain and TV-print media multitasking has negative effects on information gain.

In addition, it is noteworthy that although those who were in the TV-Internet multitasking group were not directed to search for relevant content online, many did voluntarily search for relevant information online, and those who engaged in online search reported a higher level of information gain than those in the TV-print media multitasking group. The results suggest that greater information gain found for the TV-Internet (vs. TV-print media) multitasking group can be attributed to online search. The knowledge level of those who were in the TV-Internet multitasking group but did not engage in online search was no different than those in the TV-print multitasking condition. In a natural situation of TV-Internet multitasking, media users may or may not search for information on the Internet. Their level of information is likely to increase only when they engage in online information search.

General discussion

In this study, we examined the facilitating role of Internet-based multitasking in information gain. The results of Study 1 (based on survey data) suggested that Internet-based multitasking (i.e., TV-Internet multitasking) was positively related to information gain, whereas TV-print media multitasking was negatively related to information gain. The effect of TV-Internet multitasking on information gain was found across different types of knowledge, including consumer knowledge (Study 1) and health knowledge (Study 2). In addition, the results of Study 2 (based on experimental data) showed that the participants in the TV-Internet multitasking group demonstrated a higher level of knowledge than those in the TV-print media multitasking group. Taken together, the results suggest that the two types of multitasking may have different effects on information gain. This is because when individuals engage in Internet-based multitasking, they are able to seek additional information online, which may facilitate media-based learning. On the other hand, multitasking that combines traditional media may limit information processing, which can interfere with learning.

The facilitating role of Internet-based multitasking in information processing may explain the somewhat inconsistent results found in previous research on the effects of multitasking. Although previous studies have shown that multitasking generally has negative effects on information processing (e.g., Armstrong and Chung 2000; Bowman et al. 2010; Pool et al. 2003), there is some evidence that multitasking can increase media effects (Collins 2008). To explain these mixed results, we carefully examined specific types of multitasking and predicted that Internet-based multitasking and non-Internet-based

multitasking would have differential effects on knowledge gain. Consistent with this prediction, we found a facilitating role of TV-Internet multitasking and an inhibiting role of TV-print media multitasking in knowledge gain.

These results have important implications for research on media-based learning. For example, although not in the context of multitasking, Beaudoin (2008) found synergies between TV and the Internet but not between TV and print media. In other words, those receiving news from TV and the Internet showed a higher level of knowledge than those receiving news from TV and newspapers. Although Beaudoin explained the findings based on differences in the characteristics of various types of media, his findings may also be explained by multitasking. News consumers receiving information from TV and the Internet may be multitasking while using the two media, resulting in increased knowledge.

In addition, Collins (2008) showed that multitasking can increase media effects; however, she did not demonstrate the process by which Internet-based multitasking increases media effects. The results of the present study suggest that Internet-based multitasking can facilitate information gain by promoting online information seeking. In other words, because individuals are likely to search for additional information online when they engage in Internet-based multitasking, they are likely to gain information from the traditional media with which they multitask.

These results suggest a need to pay close attention to the unique characteristics of the Internet when examining the effects of multitasking. Unlike traditional media such as TV and newspapers, the Internet, regardless of platform (e.g., a computer or a smartphone), provides an opportunity for additional information seeking. This opportunity helps users to acquire knowledge when they multitask with the Internet. It should be noted that Internet-based multitasking (e.g., TV-Internet multitasking) is no less distracting than other forms of multitasking (e.g., TV-print media multitasking). However, Internet-based multitasking can have beneficial effects on knowledge gain because it allows for additional information seeking, which can overcome the negative effects of distraction due to multitasking.

The positive role of TV-Internet multitasking in information processing has important implications for agenda-setting theory and research. Although the original agenda-setting theory has focused primarily on issue importance (i.e., public agenda) as a result of exposure to media, recent research on agenda-setting has proposed second-level agenda-setting effects, including the effect of media on the public's behavior (e.g., Coleman and Banning 2006; Moon 2011; Weeks and Southwell 2010) and intermedia agenda-setting effect, such that the agenda in a particular medium can set the agenda for other media (Danielian and Reese 1989; Sweetser et al. 2008). These types of extended agenda-setting effects may increase due to Internet-based multitasking. Traditional media, such as television media, may influence the public agenda, and subsequently affect behaviors. In addition, TV-Internet multitasking may also increase the public's participation in online discussions after exposure to television agendas.

The relationship between media ownership and information gain has important implications for those designing advertising, health, or political campaigns. Zigmond and Stipp (2010) argued that multitasking could be an opportunity for advertisers by enhancing information seeking. Thus, commercial, health, or political campaign practitioners should have a better understanding of heavy multitaskers and understand how to encourage them to seek additional information about campaign messages. The present study suggests that younger individuals and those who own a smartphone or those who own an Internet-enabled computer and a TV in the same room at home would be appropriate target audiences for campaign messages that encourage further information seeking about the campaign topic. Education and income were not significant predictors of online

information search. Future research may examine the message factors (e.g., novelty) and audience factors (e.g., perceived relevance) that facilitate information search.

The relationships between technology ownership, Internet-based multitasking, and information gain could be viewed in the context of the digital divide, which refers to the inequalities in the use of and access to information technology (e.g., Norris 2001; Servon 2002; Witte and Mannon 2007). Although previous studies of the digital divide initially focused on physical access, recent studies have explained it in terms of skills (van Deursen and van Dijk 2011) or the lack of interest and costs (Eynon and Helsper 2011) and found that it may lead to knowledge gaps (Eynon and Helsper 2011). The results of the present study suggest that media access (e.g., smartphone ownership) can guide different media behavior (e.g., Internet-based multitasking), which can subsequently result in knowledge gaps. Although previous studies of the digital divide have focused mainly on the digital divide arising from computer-based Internet use (e.g., Jung 2008), the present study suggests that smartphone-based Internet use can lead to a digital divide. In this regard, future research should examine the long-term effects of media ownership and Internet-based multitasking on knowledge acquisition.

This study has some limitations. Although we considered a sample of adults who were not college students, the sample is not representative of the population. Thus, future research should verify this study's results by considering more representative samples from various countries. In addition, we tested the acquisition of knowledge by considering only a few topics (e.g., new technologies and health). Thus, future research should examine knowledge gain by considering a wider range of topics (e.g., social and political issues).

Despite these limitations, this study contributes to the multitasking literature by examining the differential effects of TV-Internet multitasking and a more conventional form of multitasking (i.e., TV-print media multitasking) on information gain and demonstrating the mediating role of online information seeking in the relationship between Internet-based multitasking and information gain.

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