university of groningen

University Medical Center Groningen

University of Groningen

Second screening for news

Schaap, Gabi; Kleemans, Mariska; Van Cauwenberge, Anna

Published in:
Computers in Human Behavior

DOI:
10.1016/j.chb.2018.02.006

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2018

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):
Schaap, G., Kleemans, M., & Van Cauwenberge, A. (2018). Second screening for news: Effects of presentation on information processing and program liking. *Computers in Human Behavior*, *84*, 76-85. https://doi.org/10.1016/j.chb.2018.02.006

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license. More information can be found on the University of Groningen website: https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment.

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): http://www.rug.nl/research/portal. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Download date: 23-04-2025

Computers in Human Behavior 84 (2018) 76–85

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Second screening for news: Effects of presentation on information processing and program liking

Gabi Schaap [a, *], Mariska Kleemans [a], Anna Van Cauwenberge [b]

[a] Behavioural Science Institute, Radboud University, PO Box 9104, 6500 HE Nijmegen, The Netherlands
[b] Research Centre for Media and Journalism Studies, University of Groningen, PO Box 716, 9700 AS Groningen, The Netherlands

ARTICLE INFO

Article history:
Received 5 October 2017
Received in revised form
25 January 2018
Accepted 8 February 2018
Available online 20 February 2018

Keywords:
Second screen
News
Information processing
Program liking
Cognitive load

ABSTRACT

This study investigated the effects of second screen presentation mode on information processing and program liking. In an experiment, 121 participants watched a television news program. One group was assigned to a dual screen condition in which participants were required to actively look up additional information on a second screen ('look-up condition'), while a second group were assigned to a dual screen condition in which participants were directly presented with the additional information on the second screen, with no looking-up required ('presented information condition'). In a third condition, the single-screen condition, participants merely watched the news program. Results show that second screening negatively impacts factual recognition and program liking, regardless of presentation mode. While cued recall of information was lower in the second screen conditions than in the single screen condition, participants in the condition with presented information scored significantly higher on cued recall compared to the look-up condition. Analyses show the effects can be explained by the different levels of cognitive load elicited by different presentation modes.

© 2018 Elsevier Ltd. All rights reserved.

Second screening is the new normal, proclaims a Forbes article (Bercovici, 2014). A second screen refers to a companion device viewers use when watching television, whether it is a smartphone, tablet, laptop, or computer (Lee & Andrejevic, 2013). Audiences increasingly do so: while in 2013 almost half of smartphone and tablet users said they used their device during television viewing, in 2015 this had increased to 87% (Accenture, 2015; Nelsen, 2013). According to a 2016 survey, 93% of US respondents claimed they use their smartphone during watching, making it one of the most popular activities for second screen users (Statista, 2016). Thus, television watching as a passive single-screen activity is rapidly becoming a thing of the past.

The exponential rise in second screening has been an important incentive for the entertainment industry for developing applications for enhancing viewer experience, increasing program or advertising attention, and strengthening audience connections (Lee & Andrejevic, 2013; Lochrie & Coulton, 2012). But the rise in second screening is also relevant for newsmakers. The most popular use of second screens is searching for additional information: about 40% of users access live information about the program they are watching (Nelsen, 2013). Moreover, a central motivation for second screen use while watching news programs is pursuing further information (Gil de Zúñiga, Garcia-Perdomo, & McGregor, 2015). For this reason, some news organizations have embraced second screening applications, for instance to direct users to supplemental content online (Horning, 2017). Importantly, recent research indicates that second screening for news is a significant predictor of online political participation and a key link between television news and political engagement (Gil de Zúñiga et al., 2015). Thus, second screening for news may be an important new mobilizer in civic life. Using knowledge from cognitive load theory, entertainment research, and persuasive communication, the present study addresses the question how to optimize information presentation on the second screen.

While opportunities for industry and users continue to grow, one of the main questions of interest for both industry and scholars, particularly in the domain of news, remains how to present supplementary information on a second screen in order to effectively transfer information (Choi & Jung, 2016; Lee & Andrejevic, 2013). We know relatively little about the influence of different types of information presentation on second screens on users (Choi & Jung, 2016; Hwang, Kim, & Jeong, 2014; Jeong & Hwang, 2016).

* Corresponding author.
E-mail addresses: g.schaap@maw.ru.nl (G. Schaap), mariska.kleemans@bsi.ru.nl (M. Kleemans), a.m.l.van.cauwenberge@rug.nl (A. Van Cauwenberge).

https://doi.org/10.1016/j.chb.2018.02.006
0747-5632/© 2018 Elsevier Ltd. All rights reserved.

Therefore, the present study examines whether different modes of presentation of information on a second screen (i.e., users either actively look up related information or get directly exposed to presented information) affect cognitive processing (recognition and cued recall) in comparison to single-screen news watching.

While effective information transfer to the audience is a primary function of news, program liking may be an additional important factor determining audience connection to the news program. News can only fulfill its informative function if audiences not only learn from it (information processing) but also rate the program positively enough to want to (re)watch it (liking) (Kleemans, 2013; Webster & Wang, 1992). Liking is assumed to be highly predictive of exposure to a news program (Bailey, Fox, & Grabe, 2013; Hendriks Vettehen, Nuijten, & Peeters, 2008). The present study is the first to investigate the impact of second screening on news program liking.

Cognitive load theory provides a helpful framework to understand how information may be presented so that it optimizes learner performance (Sweller, Van Merrienboer, & Paas, 1998). Following this theory, it is expected that cognitively less demanding presentation formats improve cognitive outcomes. Insights from persuasive research and entertainment research provide a basis for hypotheses on program liking. Accordingly, this study investigates which presentation mode fosters or impedes cognitive load and how cognitive load subsequently affects information processing and program liking.

1. Theory and hypotheses

1.1. Cognitive effects of second screening: cognitive load

To answer the question what mode of presentation would improve information transfer in second screening situations, we turn to information processing theories. Second screening can be defined as a form of media multitasking (Choi & Jung, 2016; Van Cauwenberge, Schaap, & Van Roy, 2014). In multitasking, users perform two cognitive tasks simultaneously or switch between tasks rapidly (Lang & Chrzan, 2015). At the core of the various theories describing (media) multitasking as a cognitive process is the assumption that although humans possess unlimited long-term memory, working memory capacity is limited (Lang, 2000; Salvucci & Taatgen, 2008; Sweller, 2010; Wickens, 2002). If multiple concurrent tasks tap the same working memory resources to encode, store, and retrieve information, resources must be distributed across tasks, thereby depleting them. This ultimately results in a diminished cognitive performance, such as information retrieval and comprehension, or task performance. The burden placed on working memory during information processing is called cognitive load (Sweller, 1994). According to cognitive load theory, cognitive load depends on the interaction between the demands posed on working memory resources by the task and the user's cognitive capability (i.e. willingness and ability to process information) (Paas, Renkl, & Sweller, 2003). Thus, impaired information retrieval is a consequence of high cognitive load, and learning from media can be improved by decreasing load (Mayer, Moreno, Boire, & Vagge, 1999).

Cognitive load theory has the specific aim of developing presentation modes that enhance learner performance through decreasing cognitive load (Sweller et al., 1998). The theory distinguishes between three sources of cognitive load: germane (i.e., the willingness of a person to invest cognitive resources in relevant schematic processing), intrinsic (i.e., the demands made on working memory imposed by intrinsic stimulus characteristics), and extraneous cognitive load (i.e., the load placed on the cognitive system by the way in which the task or stimulus is presented) (Paas et al., 2003). Different degrees of each of these types of cognitive load lead to different degrees of performance success. As in everyday situations optimizing germane load is not within reach of news producers, in the current study we are interested in the effects of presentation modes, all else being equal. Therefore, the present study will focus on intrinsic and extraneous cognitive load, and not on germane cognitive load.

Intrinsic cognitive load is the cognitive effort associated with a specific task. This effort depends on the interaction between the inherent complexity of the (learning) task and the learner's expertise (Paas et al., 2003). In line with this idea, meta analyses of media multitasking research have identified that the amount and type of resource demands required by a task determine the extent to which processing systems become overloaded (Jeong & Hwang, 2016; Lang & Chrzan, 2015). The intrinsic load of using two screens simultaneously is higher compared to using a single screen, because the user processes information from two separate visual input sources. One reason for this is that processing information from two screens requires the sharing of the same visual sensory resources. In addition, using two separate screens introduces physical distance between the two tasks, which leads to additional processing demands (Wang, Irwin, Cooper, & Srivastava, 2015). While the presentation of separate parts of information within one single platform can diminish intrinsic load, the absence of an integrated information design results in increased cognitive load. The reason for the latter is that the cognitive system has to carry the load of integrating the separate information presentations (Chandler & Sweller, 1991; Jeong & Hwang, 2016; Moreno & Mayer, 1999; Wang et al., 2015; Van Merriënboer & Ayres, 2005). Prior research has confirmed this reasoning for second screening with news programs (Van Cauwenberge et al., 2014). Therefore, we predict that:

H1. Second screening while watching a news program will lead to higher cognitive load than single screening (watching only the news program).

So, in line with cognitive load theory, second screening can be seen as an intrinsic characteristic of the learning task – i.e. processing two screens simultaneously – contributing to cognitive load. But how can we design second screen applications that limit cognitive load? Cognitive load theory offers explanations as to how presentation mode or difficulty may affect cognitive load. Extraneous cognitive load refers to the load induced by the presentation of learning tasks (Paas, Renkl et al., 2003; Paas, Tuovinen et al., 2003; Sweller et al., 1998). One of the main posits of the cognitive load literature is that, from a working memory perspective, many learning designs are inadequate because they present the material in ways that elicit high extraneous load. Presenting complex tasks in a relatively simple manner should decrease extraneous load and improve subsequent performance, memory, and comprehension of materials (Sweller et al., 1998).

In media multitasking research, it has been established that task input, including how information is presented in media multitasking situations, is a major factor in determining multitasking effects (Wang et al., 2015). As information presentation is the one dimension affecting cognitive load that is under the greatest control of message designers, the design of information presentation provides the greatest opportunity to influence successful implementation of second screening in news production. There are several options to reduce cognitive load, some of which are less feasible or practical as they are intrinsic to a two-screen 'task' in which one of the screens involves television –e.g., eliminating one screen, or using only sound on the second screen device (Mayer & Moreno, 2003; Wang et al., 2015). Studies on TV news presentation found that simplifying presentation by eliminating extraneous

stimuli significantly improved attention and factual recognition (e.g., Bergen, Grimes, & Potter, 2005). In the current study we simplify the task by 'weeding' out extraneous input, reducing the need to process extraneous input (Mayer & Moreno, 2003).

In their study on the effects of relevant and irrelevant second screening, Van Cauwenberge et al. (2014) let participants look up information on a second screen that was either relevant or irrelevant to the information on the first screen. They found that second screening had a negative effect on cognitive load and processing of first screen information, whereas, unexpectedly, they found no difference between relevant or irrelevant second screening. Extraneous load may explain the latter finding, as it may emanate from using a relatively complex way to offer the information. The participants were required to find the answer to a number of basic questions by using an Internet search machine. Research from cognitive load theory has found that instructional procedures requiring learners to engage in searches for information of any kind impose a heavy extraneous cognitive load, as working memory resources must be used for activities that are irrelevant to learning (Paas, Renkl et al., 2003; Paas, Tuovinen et al., 2003).

To look up information on the web, the user must type in search terms and navigate links, which takes up cognitive resources, and increases cognitive load (DeStefano & LeFevre, 2007; Eveland & Dunwoody, 2000). Research on web interactivity and hyperlink effects shows that navigating the Internet may lead to increased load, for instance due to frequent orienting problems (Eveland & Dunwoody, 2000, 2001). Finally, web pages often contain distracting features, such as irrelevant images or advertising (Diao & Sundar, 2004). All this means that cognitive load increases, and relevant resources are taken away from processing information from the first screen.

This study tests the assumption that information on a second screen may be presented in such a manner that it reduces extraneous cognitive load. Building on the findings of Van Cauwenberge et al. (2014) and Mayer and Moreno (2003), in this study we manipulate one aspect of presentation: the extent to which users are required to search additional information themselves. Specifically, this study presents information on a second screen in one of two ways: either by having participants search for relevant supplementary information themselves in an Internet search machine, or by presenting them the relevant information directly. In the latter, cognitively much less demanding presentation format, we expect the causes for cognitive load described above to be much diminished.

In sum, whereas cognitive load is intrinsic to the complex task of processing information from two screens simultaneously, the mode of information presentation affects extraneous cognitive load. Consequently, in this study we expect that presenting information in a way that invokes less extraneous cognitive load, will lead to more successful information processing than information that evokes higher levels of extraneous cognitive load:

H2. Cognitive load will be lower when information on the second screen is presented, as compared to information that must be looked up.

1.2. Cognitive effects of second screening: information retrieval

As said, cognitive load is the extent to which cognitive resources of the same type are depleted by one or multiple tasks. The degree to which this occurs subsequently affects processing outcomes: the higher the load, the higher the memory and performance decrements. Research strongly points to the detrimental effects of media multitasking for processing outcomes, especially memory-related tasks (Courage, Bakhtiar, Fitzpatrick, Kenny, & Brandeau, 2015; Jeong & Hwang, 2016; Lang & Chrzan, 2015). A smaller number of studies have shown that second screening—as a specific form of media multitasking—reduces task performance, information recollection and comprehension (Jeong & Hwang, 2012; Van Cauwenberge et al., 2014; Voorveld, 2011; Zhang, Jeong, & Fishbein, 2010). In the current study, we have participants watch a news program in either a single screen condition or in one of two conditions in which they use a second screen to obtain relevant supplemental information. As second screening will at least partially require simultaneous tapping of the same processing systems (visual sensory systems), we predict that second screening will lead to decreased information processing efficiency. Information processing consists of several distinguishable sub-processes, which can be measured in specific ways (Lang, 2000). In research, recognition and cued recall measures are often used as indicators for the first and second steps in processing: encoding, and storage of information respectively. We predict:

H3a. Second screening while watching a news program will lead to lower recognition than single screening.

H3b. Second screening while watching a news program will lead to lower cued recall than single screening.

However, in line with cognitive load theory, if cognitive load can be reduced, for instance by constructing a less taxing presentation of information on the second screen, we would expect the presentation of relevant information on a second screen to have a less taxing effect on working memory compared to looking up relevant information themselves, consequently leading to improved memory:

H4a. Recognition will be higher when information on the second screen is presented, as compared to information that must be looked up.

H4b. Cued recall will be higher when information on the second screen is presented, as compared to information that must be looked up.

1.3. Effects of second screening on program liking

Beyond cognitive outcomes, it is important to investigate how second screen presentation affects the audience's inclination for repeated viewing of the news program, because the informative function of news partly depends on (the willingness for) frequent news exposure (cf. Kleemans, Hendriks Vettehen, Eisinga, & Beentjes, 2014). It seems a fair assumption that news viewers watch a program at least in part if they like it (Zillmann & Bryant, 1985). Indeed, research into the content and packaging of television news has found a number of indications for this assumption (cf. Bailey et al., 2013; Hendriks Vettehen et al., 2014). Therefore, in the present study we are interested in whether different modes of presentation of information on a second screen affect liking of the first screen content. Although prior research indicates that second screening has negative effects on cognitive outcomes, it may have more positive consequences for affective or attitudinal outcomes (Jeong & Hwang, 2016). For instance, findings from academia and the industry suggest that in entertainment and advertising second screen applications do work in terms of increasing audience engagement, provided they are adjusted to first screen tone, style, and pacing (Lee & Andrejevic, 2013).

In a survey study, Wang and Tchernev (2012) found that while cognitive needs (getting informed) are not fulfilled by media multitasking, affective needs are. Media multitaskers appear to get a sense of fulfillment when they are multitasking —even though

their actual performance is harmed. Multitasking seems related to positive affects such as happiness and enjoyment (Kononova & Chiang, 2015). Experimental studies have found a similar positive relation between multitasking and evaluation of the experience or media content. One study found that using second screens had a positive impact on user satisfaction, perceived usefulness and intent to use the service in the future (Choi & Jung, 2016). Two others found second screening and simultaneous consumption of advertising through separate media increased overall task and ad enjoyment and evaluations (in terms of liking, positive evaluation and pleasantness) (Chinchanachokchai, Duff, & Sar, 2015; Voorveld, 2011). In persuasive research, this has been explained by the fact that multitasking impedes elaborative processing and counter-arguing with the content of a persuasive message (Jeong & Hwang, 2012; Yoon, Choi, & Song, 2011). As cognitive resources are taken up by the secondary task, this leaves only sufficient capacity for superficial processing of an inherently enjoyable message, where high effort is needed for reactance to the message's persuasive content.

Outside the realm of media, the effect can be explained by the positive affective feedback one gets from doing moderately challenging tasks. The concepts of 'flow' (Csikszentmihalyi, 1990) or optimal stimulation (e.g., Mehrabian & Russell, 1974) attest to the same line of thinking: that very low levels of stimulation are aversive, and people will work to increase stimulation. Multitasking can be one way to increase stimulation, and heighten a task's entertainment level (Chinchanachokchai et al., 2015; Duff, Yoon, Wang, & Anghelcev, 2014; Jeong & Fishbein, 2007). Therefore, we hypothesize that second screening leads to more liking of the news content:

H5. The news program on the first screen will receive higher liking ratings in the second screen conditions, as compared to the single screen condition.

But too much stimulation can be unfavorable as well, especially if the task transcends skill levels. So, in using media technology people will strive for an optimal stimulation level because it makes them feel good (Agarwal & Karahanna, 2000; Chinchanachokchai et al., 2015; Hoffman & Novak, 2009; Huang, 2006). As we have seen, however, media multitasking can lead to cognitive overload. In order to appreciate media content, sufficient cognitive capacity is needed. Entertainment research shows that introducing interactivity increases positive evaluations of films, but only when users have sufficient cognitive capacity (Vorderer, Knobloch, & Schramm, 2001). If users are overwhelmed or distressed by the interactivity, their ratings drop. Other research indicates that feeling cognitively overloaded is correlated with negative ratings of news (York, 2013). One study investigated the effect of presentation modality and user control on news credibility and enjoyment, and found mixed results (Horning, 2017). While we expect that multitasking may lead to higher liking of the first screen content (see H5) when compared to single screening, we expect that having people look up information on the second screen produces too much of a cognitive challenge compared to being presented information. This will lead to lower program liking than presenting the information directly on the second screen:

H6. Liking of the program will be higher when information on the second screen is presented, as compared to information that must be looked up.

1.4. Cognitive load as mediator

In all processes above, cognitive load is a central factor. First, cognitive resources are needed for encoding and storing information. If multitasking conditions increase working memory load, either by presenting a second screen versus a single screen (cf. Van Cauwenberge et al., 2014) or by various ways of presentation on the second screen (cf. Mayer & Moreno, 2003), subsequent information retrieval will suffer. Therefore, we expect that when comparing the two second-screen conditions, the condition eliciting the lowest load (presented condition) will subsequently yield the highest information retrieval. In other words, cognitive load mediates the effect of second screening presentation on information recognition and cued recall:

H7a. The effect of second screen condition on recognition is mediated by cognitive load. The higher cognitive load for the look-up condition will result in decreased recognition, while the lower cognitive load for the presented information condition will lead to a higher recognition.

H7b. The effect of second screen condition on cued recall is mediated by cognitive load. The higher cognitive load for the look-up condition will result in decreased cued recall, while the lower cognitive load for the presented information condition will lead to a higher cued recall.

Likewise, a higher cognitive load may mediate the effects of second screening on liking. As argued above, when comparing the two second screen conditions, the condition leading to the highest cognitive load (look-up condition) would lead to insufficient resources to appreciate the program, and subsequently to lower liking, whereas the smaller cognitive load elicited by the presented information condition leads to comparatively higher liking. Therefore, we expect that cognitive load mediates the effect of second screening on program liking:

H8. The effect of second screen condition on liking is mediated by cognitive load. A higher cognitive load for the look-up condition will lead to lower program liking, whereas the lower cognitive load in the presented information condition will lead to higher program liking.

2. Method

2.1. Design

This study investigated the effect of second screen presentation mode on recognition, cued recall, and program liking in an experiment using a 3 (second screen condition: single screen, look up, presented information) x 2 (news topic: topic 1, topic 2) mixed design, in which second screen condition was the between-subjects factor and news topic was the within-subjects factor. Participants in all conditions were asked to watch a short edited news program containing two news items, which were presented in a randomized order. In the two second screen conditions, participants used a second monitor to retrieve supplemental information in order to fill out a questionnaire.

2.2. Participants

Participants ($N = 121$) were recruited through a recruitment portal from a university in the Netherlands. Of the total sample with an average age of 21.78 years old ($SD = 2.53$; min-max = 18–33), 110 participants were female (82,6%). All participants gave active consent for participation, and the researchers ensured total anonymity and confidentiality of the data. They received either study credits or a gift certificate valued at €5 for their participation.

2.3. Procedure

Upon arrival, participants were directed to a room in the university lab, and seated behind a desk containing one computer screen in front of them and another screen directly next to it. Before starting the experiment, participants were informed that the study involved watching a news program. Subsequently, participants received the instruction to watch the news program on the main screen in front of them attentively. In the two second screen conditions, they were instructed to watch the program while simultaneously answering six news-related questions (three per news story) on a paper questionnaire by looking up the answers on a second screen. The second screen showed either the homepage of the Internet search machine Google (look-up condition) or a page providing the information needed to answer the news-related questions (presented information condition). In the look-up condition, participants were instructed to look up the answers using the browser on the second screen. In the presented information condition, they were asked to get the answers from the information presented to them on the second screen. In the experimental conditions, the screens automatically switched on as soon as the news program started. In the control condition, the second screen remained switched off.

Following the news program, participants filled out an online questionnaire. First, they received four cued recall questions for each of the two news stories. These were followed by four recognition questions for each story. Next, two questions measuring cognitive load, and two on news program liking, were asked. The questionnaire ended with two background questions. Following the questionnaire, the participants were thanked and debriefed. The entire procedure lasted around 30 min.

2.4. Materials

A news program was constructed using existing news reports from the main Dutch public news broadcaster, NOS 8 uur journaal. The program was edited so that it looked like a normal newscast, with only two reports. We included two different news topics to increase generalizability of the findings. Moreover, with more than one story, we can rule out that the topic itself rather than the second screen task influenced the results. In all, the program ran 6:20 min, including introduction, bumpers, and outro. One news item detailed the intensified border checks of train passengers crossing the Danish border, because of increased pressure of illegal aliens coming into the country. This caused great delays for passengers, and the prime minister expressed his sorrow on having to resort to these measures (total duration: 3:13 min). The other news story reported on heavy winter weather in the Netherlands. This caused problems in certain regions with high voltage power cables. Authorities issued an increased alert for the general public (total duration: 2:56 min). The news program was shown on the main screen directly in front of the participants.

The second screen was used to obtain information in order to answer a number of news-related questions. As none of these questions were directly addressed in the program, the answers had to be looked up by means of a second screen. In the look-up condition, participants used the Google search machine start page to begin their search. The answers to the questions could easily be found in the first or second hit in the search machine. In the presented information condition, text screens containing the supplemental information to answer the questions were shown, one screen for each news story. These screens were synchronized with the duration of each news story, starting when the corresponding news item started and ending when the item did. The pages consisted of a white background with, outlined in the upper left corner, three brief paragraphs of 1–3 sentences containing the information needed to answer the questions, with short summarizing headers.

2.5. Measures

2.5.1. Cognitive load

Following Schmeck, Opfermann, van Gog, Paas, and Leutner (2015), the questionnaire assessed two aspects of cognitive load: mental effort invested (Paas, van Merriënboer, & Adam; 1994; Paas et al., 2003) and perceived difficulty (Kalyuga, Chandler, & Sweller, 1999). We used two items: “How hard was it for you to understand the news?” (1 = very easy, 7 = very hard), and how much mental effort did you need to understand the news?” (1 = very little, 7 = a lot). Mean scores were calculated for each participant in a composite measure for the two news stories together ($M = 3.67$; $SD = 1.58$; min-max = 1.00–7.00). At $\alpha = .82$, reliability of the scale was good.

2.5.2. Recognition

Recognition was measured using four multiple-choice questions for each news story, each question with four answer options. For the ‘bad weather’ report, questions were “How many volts are there on high-voltage cables?”; “A Code Orange was given for two regions, which regions are they?”; “What happens during so-called ‘line dancing’?”; “Who is the grid operator?”. For the ‘border inspection’ story, the items were: “How much delay do the inspections cause?”; “How long are they planning to continue the inspections?”; “How many refugees have already entered Sweden?”; What is the name of the prime minister of Denmark ?”. Scores 1 for right answers and 0 for false answers were added into a composite (two stories together) sum score for each participant ($M = 3.66$; $SD = 1.83$, min-max = 0–8.0).

2.5.3. Cued recall

Cued recall was measured using four open-ended questions per news story. The four questions addressed basic Who What, Where, and Why elements of the story. For the ‘border inspection’ story, they were: Where are the border controls taking place?”; “Who is being checked?”; “What is the reason the prime minister is not pleased by having to close the border?”; and “Why is the man who brought is child to his ex-wife not allowed to return?”. For the ‘bad weather’ story they were: “Why are the public transport companies going to ride only empty trains?”; “What causes the flickering of light?”; “Who gave the advice to stay off the road?”; How many operations did the medical center postpone?”

Answers to the open ended questions were coded 0 for incorrect answers, 1 for correct answers, and 0.5 for partially correct answers. A composite sum score (two news stories together) was calculated for each participant to indicate cued recall ($M = 4.32$, $SD = 1.86$, min-max = 0–7.50).

2.5.4. Liking

Following Hendriks Vettehen et al. (2008), we measured program liking using two items on a seven-point scale (1 = completely disagree, 7 = completely agree): “I liked watching this news program”, and “This was an attractive news program”. Hendriks Vettehen et al. (2008) show that these two items constitute one factor, dubbed ‘liking’. Mean scores were calculated for liking ($M = 4.61$, $SD = 1.19$; min-max = 2.00–7.00). Reliability of the scale was good at $\alpha = .81$.

2.6. Analysis procedure

To test hypothesis 1 to 6, one-way ANCOVAs were performed

with condition (single screen, look-up, presented information) as between-subjects variable. In all analyses, we controlled for age and gender. The hypotheses were tested at the alpha = .05 level (two-tailed). Hypothesis 7 and 8, were tested using the PROCESS macro (Hayes, 2013). OLS regression and bootstrapping with 5000 bootstrap samples and 95% bias-corrected confidence intervals were used to estimate the indirect effects of second screen watching via cognitive load on respectively recognition, cued recall, and story liking.

3. Results

3.1. Preliminary checks

To test whether the randomization was successful, we checked the division of the participants (gender and age) over the three second screen conditions (i.e., the between-subjects variable in this experiment). There were no significant differences between the three conditions for gender $X^2(2, N = 121) = .352$, $p = .839$, and age $F(2,117) = 1,106$, $p = .334$. We conclude that randomization was successful. We used confirmatory factor analysis (CFA) to get indications for the structural validity of the questionnaire items for the cognitive load and liking concepts, using the Lavaan package (Rosseel, 2012) in R version 3.4.1 (R Core Team, 2016). Results show the model provides an acceptable fit to the data, $\chi^2(1) = 0.004$, $p = .952$, CFI = 1.000, TLI = 1.033, RMSEA < .001, 90% CI [.000, .000]. As expected, the indicators all showed significant positive factor loadings, with standardized coefficients all >.70. This indicates that the questionnaire items on cognitive load and liking were suitable for measuring the target concepts.

3.2. Direct effects of second screen viewing

3.2.1. Effects on cognitive load

The first hypothesis predicted that second screening while watching news would lead to higher cognitive load than single screening. A significant main effect of condition on cognitive load was found, $F(2,115) = 15.261$; $p < .001$; $\eta^2_p = .10$. In line with hypothesis 1, post-hoc comparisons using Bonferroni correction showed that cognitive load was significantly lower in the single screen condition ($M = 2.69$; $SE = .22$) compared to both the look up condition ($M = 4.23$; $SE = .22$; $p < .001$) and the presented information condition ($M = 4.14$; $SE = .22$; $p < .001$). The difference between the two second screen conditions, however, was not significant ($p = 1.000$). This implies that we must reject hypothesis 2 which predicted that cognitive load would be lower when information on the second screen was presented as fixed information bits, as compared to information that had to be looked up.

3.2.2. Effects on recognition and cued recall

Hypothesis 3a predicted a negative effect of second screening on recognition. The results showed a main effect of condition, $F(2,115) = 17.197$; $p < .001$; $\eta^2_p = .23$. Participants in the single screen condition had a significant higher recognition of information provided in the newscast ($M = 4.90$; $SE = .26$) compared to participants who also looked up information ($M = 2.96$; $SE = .26$; $p < .001$) or who saw presented information on a second screen ($M = 3.15$; $SE = .26$; $p < .001$). Again, no difference between the look-up and presented information condition was found ($p = 1.000$), which runs counter our prediction as formulated in hypothesis 4a, that the presented information condition would lead to higher recognition.

Hypothesis 3b predicted the same effects for cued recall. Results showed an effect of condition, $F(2,115) = 23.635$; $p < .001$; $\eta^2_p = .29$. Cued recall was higher among those in the single screen condition ($M = 5.54$; $SE = .25$) compared to both the look up condition ($M = 3.10$; $SE = .25$; $p < .001$) and the presented information condition ($M = 4.28$; $SE = .25$; $p = .002$). In addition, as predicted in hypothesis 4b, cued recall was significantly higher in the presented information condition than in the look up condition ($p = .004$).

In all, these results provide support for hypotheses 3a and b, by showing that second screening leads to lower recognition and cued recall. However, only cued recall was higher when information on the second screen was presented as fixed information bits compared to information that had to be looked up (H4b).

3.2.3. Effects on liking

The fifth hypothesis predicted that the first screen program would be more liked in the second screen conditions, as compared to the single screen condition. However, the results did not support this prediction, $F(2,115) = 3.279$; $p = .041$; $\eta^2_p = .05$. Post-hoc comparisons showed that program liking was significantly higher ($p = .035$) among participants in the single screen condition ($M = 4.96$; $SE = .19$) compared to the look up condition ($M = 4.28$; $SE = .19$). Liking did not differ ($p = .609$) between single screen watching and second screen watching including presented information ($M = 4.62$; $SE = .19$). Also hypothesis 6, predicting that liking of the program would be higher when information on the second screen was presented, as compared to information that must be looked up must be rejected. Program liking did not significantly differ between the two second screen conditions ($p = .627$).

3.2.4. The mediating role of cognitive load

To test whether and how effects of second screening are mediated by cognitive load (hypotheses 7a and b, and 8), we used Hayes' (2013) PROCESS macro (Model 4 for a multi-categorical X with 3 categories). To include our three-categorical independent variable in the model, we constructed two dummy variables (look-up second screening and presented second screening). With each run, one dummy variable was included in the analysis as the independent variable and the other as a covariate. In addition, all analyses controlled for gender and age. In the following, we use a_1 to denote the path between the look up condition and cognitive load, whereas a_2 is the path between the presented information condition and cognitive load. The b path signifies the path between cognitive load and the dependent variable, while the c paths represent the direct path between the conditions and the dependent variables.

The results for information processing (H7a, see Fig. 1) showed that a higher cognitive load did not affect recognition ($b = -.202$; $p = .062$). Moreover, there was no indirect effect of either second screening condition on recognition through cognitive load ($a_1b = -.312$), bootstrapped CI [-.754 to .034]; ($a_2b = -.295$), bootstrapped CI [-.741 to .039]. Both second screen conditions had a negative direct effect on recognition: c'_1 bootstrapped CI = [-2.415 to −.842] $p < .001$; c'_2 bootstrapped CI [-2.2(39 to −.674], $p < .001$ (Fig. 1).

A second analysis, with cued recall as outcome variable (H7b, see Fig. 2), showed that cognitive load had a significant negative effect on cued recall ($b = -.429$, $p < .001$). A negative effect of look-up second screening through cognitive load was also significant ($a_1b = -.662$), bootstrapped CI [-1.212 to −.290], as was the indirect effect of presented second-screening ($a_2b = -.625$), bootstrapped CI [-1.192 to −.253]. This means that participants with a higher cognitive load due to second screening had a significantly lower recall of the factual information in the news program. In addition, Fig. 2 reveals a significant negative direct effect of the look-up condition on cued recall: bootstrapped CI [-2.499 to −1.056], $p < .001$, but not for the presented condition: bootstrapped CI

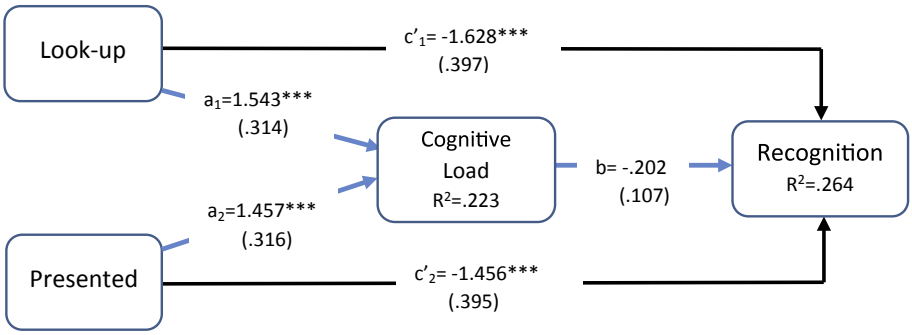

Fig. 1. Mediation model of second screening condition, cognitive load, and recognition. $^{*}p < .05$; $^{***}p < .001$ Unstandardized coefficients; standard errors in parentheses. All analyses controlled for gender and age. X→M: $F(4,115) = 8.262$, $p < .001$; X→Y: $F(5,114) = 8.155$, $p < .001$.

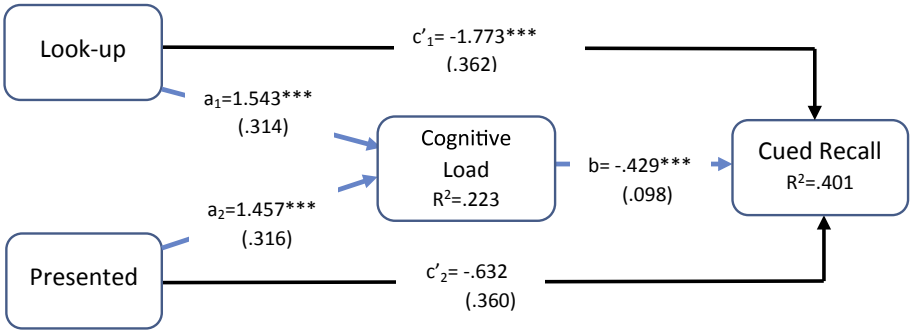

Fig. 2. Mediation model of second screening condition, cognitive load, and cued recall $^{*}p < .05$; $^{***}p < .001$ Unstandardized coefficients; standard errors in parentheses. All analyses controlled for gender and age. X→M: $F(4,115) = 8.262$, $p < .001$; X→Y: $F(5,114) = 15.269$, $p < .001$.

[-1.345 to .0581], $p = .082$ (Fig. 2). In all, this means that hypothesis 7a and b were confirmed: cognitive load mediated the effects of second screen conditions on both recognition and cued recall in such a way that a higher load results in decreased recognition and cued recall.

With regard to Hypothesis 8 (see Fig. 3), results showed that liking was significantly decreased by higher cognitive load ($b = -.344$, $p < .001$). The effect of second screening on program liking was mediated by cognitive load ($a_1b = -.531$; $a_2b = -.501$), bootstrapped CI for a_1b [-.899 to −.302], and for a_2b [-.874 to −.261]. This indicates that a higher cognitive load leads to lower news program liking, for both modes of presentation. Furthermore, neither second screen condition had a significant direct negative effect on program liking c'_1 bootstrapped CI = [-.669 to .382], $p = .589$; c'_2 bootstrapped CI [-.361 to .686], $p = .539$ (Fig. 3). Therefore, we may conclude that hypothesis 8 was confirmed.

In all, we conclude that for all outcome variables, with the exception of recognition, effects of second screening were mediated by cognitive load. While there was a significant effect of second screening conditions on cognitive load (both second screen conditions resulting in a higher cognitive load), the subsequent effect of cognitive load was only marginally significant for recognition. All other effects of cognitive load on cognitive and affective outcomes were negative: the higher the cognitive load, the lower the cued recall and program liking, with a higher cognitive load being caused by second screening during news viewing and not by differences between the two modes of presentation. However, as can be seen in the Figures, in a number of instances there were also direct effects of second screening on outcome variables that cannot explained by cognitive load.

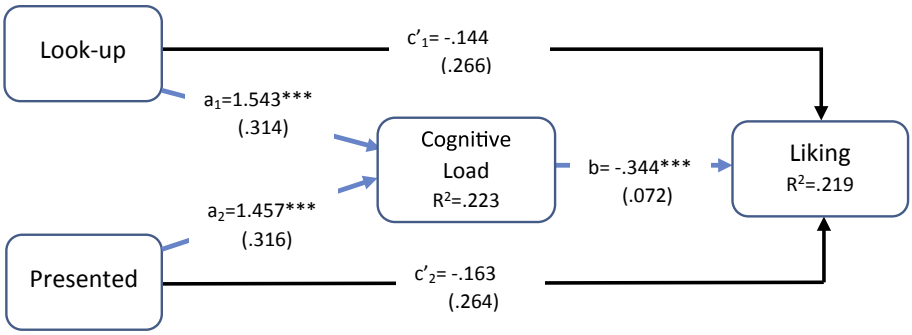

Fig. 3. Mediation model of second screening, cognitive load, and program liking. $^{*}p < .05$; $^{***}p < .001$ Unstandardized coefficients; standard errors in parentheses. All analyses controlled for gender and age. X→M: $F(4,115) = 8.262$, $p < .001$; X→Y: $F(5,114) = 6.405$, $p < .001$.

4. Discussion

Previous research on second screening demonstrated its detrimental effects on cognitive outcomes. This study set out to determine whether presentation mode could improve memory of news programs. Furthermore, it is the first study to investigate the relation between second screening and news program liking.

Most importantly, the results of the present study show that second screening increases cognitive load in individuals regardless of presentation mode on the second screen. While single tasking (watching only the news program) produces the least cognitive load, readily presenting information on a second screen – which, based on theory and prior research we assumed to be a less taxing presentation mode – does not meaningfully lessen cognitive load compared to the more demanding mode of looking up information. Furthermore, second screening negatively affects cognitive processing outcomes. Our results show that second screening while watching news leads to lower news recognition and cued recall. But whereas presentation mode on the second screen does not affect recognition, cued recall is higher when information on the second screen is presented, as compared to information that has to be looked up by means of the second screen. Thus, our results suggest that more stringent forms of news learning, such as cued recall (cf. Lang, 2000), benefit from choosing a cognitively less demanding second screen presentation mode.

Contrary to our expectation, liking is negatively affected by second screening: regardless of presentation mode, second screening produces a lower news program liking than single tasking. Cognitive load partially explains these effects: with the exception of recognition, all effects are mediated by cognitive load. These mediated pathways are the same across outcome variables: a higher cognitive load results in lower cued recall and liking.

The findings corroborate past research on second screening demonstrating that presenting relevant or irrelevant information on the second screen makes no difference in terms of information retrieval (Van Cauwenberge et al., 2014). Moreover, the study extends this line of research in providing indications that various second screen presentation modes may differentially affect cognitive load. Furthermore, although in the media multitasking domain many cognitive effects have been demonstrated, and some research exists on the relationship between multitasking with persuasive messages and counterarguing (Jeong & Hwang, 2012), this is the first study to show a relationship between second screening and affective reactions to informative messages.

Theoretically, this study contributes to second screen research in a number of ways. In line with cognitive load theory, the current study provides confirmation that in the specific context of second screening, cognitive load mediates the effects of second screening on cognition. Furthermore, considering persuasive communication and entertainment research and theories, this study strongly suggests that cognitive load is not only relevant for cognitive outcomes, but for affective evaluations of the program as well. Moreover, it suggests that in researching the cognitive effects of media multitasking and second screening, it is important to differentiate between several cognitive outcomes (cf. Lang & Chrzan, 2015).

One might ask how the differing patterns for recognition and cued recall can be explained. Recognition measures the processing of information from stimuli into representations (Lang, 2000). Cued recall measures whether the information was stored. Thus, our two different measurements tap into two subsequent steps in the processing of information in working memory. From our results we are able to gather that optimizing second screening presentation mode is more effective for the more rigorous form of learning information which is information storage. This suggests that the effect of cognitive load induced by presentation format is greater as recall measures tap a relatively taxing sub process of cognitive processing, such as information storage.

Of course in real-life, second screening is not a forced behavior, but rather an adaptive, planned, and motivated one (Shim, Shin, & Lim, 2017; Wang et al., 2015). Users can for instance choose when to use the second screen, pause it when they wish to pay attention to the first screen, or disregard it altogether. In addition, a lab study only tests static contexts, in which the user's behavior or cognitive processing may adapt to specific challenges over a longer time period. Future research may want to address these more dynamic situations. For instance, it is entirely possible that longer experience with second screening leads to an increased expertise in cognitive processing, thus reducing intrinsic cognitive load and freeing up working memory capacity (Paas, Renkl et al., 2003; Paas, Tuovinen et al., 2003). Furthermore, our study only tested one simple presentation mode. Perhaps more sophisticated modes can be devised, for instance modes sensitive to the flow of the news program and the corresponding processing efforts required, and which can dynamically insert supplemental information on the second screen at cognitively opportune moments. Moreover, a large part of second screen use in other contexts is focused on social functions (social media use during watching). While such functions may equally distract from the news program content, there may be positive effects for audience involvement and program liking. Future research may focus on both dynamic, synchronized forms of second screen information, and on the effects of social functions of second screens with news programs.

Some caution is warranted in interpreting the causal direction of the relation between our mediator, cognitive load, and the dependent variables. Strictly speaking, the study design allows only correlational inferences as cognitive load and the dependent variables were both measured through a post-test questionnaire. Though the correlation between cognitive load and cognitive processing and, especially, program liking is interesting in itself, there are reasons to believe that the proposed causal direction is valid. As explained in this paper, decades of theoretical development and empirical research in cognitive load theory, educational research, cognitive psychology, and communication science have firmly established cognitive load as a precursor to diminished cognitive performance, both in multitasking and other paradigms (e.g., Jeong & Hwang, 2016; Lang & Chrzan, 2015; Mayer et al., 1999; Paas, Renkl et al., 2003; Paas, Tuovinen et al., 2003; Sweller, 1994). Furthermore, this study is the first to suggest a relation between second screen formats, cognitive load, and program liking. Although prior research suggests the existence of at least correlations (e.g., Horning, 2017; Choi & Jung, 2016; Chinchanachokchai et al., 2015; Kononova & Chiang, 2015; Vorderer et al., 2001; Voorveld, 2011; York, 2013), we encourage future research to determine the causal direction between cognitive load elicited by second screen formats and affective evaluations of the first screen program. Related to this issue is the fact that our measurements of cognitive load and liking were fairly simple, consisting of only two questionnaire items each. Both concepts may be more complex, and future research may seek to incorporate and validate measures that represent these cognitive and affective concepts best.

One limitation of our study concerns the sample composition of a majority of females. Research suggests that men and women may in certain conditions experience different levels of cognitive load when playing games (Hwang, Hong, Cheng, Peng, & Wu, 2013). Although all our analyses controlled for gender differences, showing no significant differences on any of the outcome variables, we encourage future research to focus on more diverse demographic groups.

There are a few take-aways for newsmakers wishing to improve the effectiveness of their second screen applications. We must

conclude that, in apparent contrast to entertainment and persuasive contexts (cf. Chinchanachokchai et al., 2015; Jeong & Hwang, 2012; Lee & Andrejevic, 2013; Voorveld, 2011; Yoon et al., 2011) second screening generally seems not to be beneficial in light of the informative function of news. Both in terms of cognitive and affective rewards, watching a news program on a single screen proves far superior than using a supplemental device. Although the differential outcomes for recognition and cued recall suggest that tinkering with presentation formats may improve learning from the news somewhat, ultimately single screening is the better option if you wish to inform the audience. Television producers might be more interested in audience ratings, increasing attention, and strengthening audience connections through the enhancement of viewer experience. However, if program liking is anything to go by, second screening is unlikely to achieve these goals. It will not help to get audiences informed, and neither will it get higher program likings.

References

Accenture. (2015). *Digital video and the connected consumer*. Retrieved on 3 October, 2017, from: https://www.accenture.com/us-en/insight-digital-video-connected-consumer.

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665–694. https://doi.org/10.2307/3250951.

Bailey, R. L., Fox, J. R., & Grabe, M. E. (2013). The influence of message and audience characteristics on TV news grazing behavior. *Journal of Broadcasting & Electronic Media, 57*(3), 318–337. https://doi.org/10.1080/08838151.2013.816704.

Bercovici, J. (2014). *Second screening is the new normal*. Retrieved 1 June, 2017 from https://www.forbes.com/sites/jeffbercovici/2014/07/10/using-a-second-screen-while-watching-tv-is-now-the-norm/#18748cd918c6.

Bergen, L., Grimes, T., & Potter, D. (2005). How attention partitions itself during simultaneous message presentations. *Human Communication Research, 31*(3), 311–336. https://doi.org/10.1111/j.1468-2958.2005.tb00874.x.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction, 8*(4), 293–332. https://doi.org/10.1207/s1532690xci0804_2.

Chinchanachokchai, S., Duff, B. R., & Sar, S. (2015). The effect of multitasking on time perception, enjoyment, and ad evaluation. *Computers in Human Behavior, 45*, 185–191. https://doi.org/10.1016/j.chb.2014.11.087.

Choi, B., & Jung, Y. (2016). The effects of second-screen viewing and the goal congruency of supplementary content on user perceptions. *Computers in Human Behavior, 64*, 347–354. https://doi.org/10.1016/j.chb.2016.06.048.

Courage, M. L., Bakhtiar, A., Fitzpatrick, C., Kenny, S., & Brandeau, K. (2015). Growing up multitasking: The costs and benefits for cognitive development. *Developmental Review, 35*, 5–41. https://doi.org/10.1016/j.dr.2014.12.002.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row.

DeStefano, D., & LeFevre, J. A. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior, 23*(3), 1616–1641. https://doi.org/10.1016/j.chb.2005.08.012.

Diao, F., & Sundar, S. S. (2004). Orienting response and memory for web advertisements: Exploring effects of pop-up window and animation. *Communication Research, 31*(5), 537–567. https://doi.org/10.1177/0093650204267932.

Duff, B. R. L., Yoon, G., Wang, Z., & Anghelcev, G. (2014). Doing it all: An exploratory study of predictors of media multitasking. *Journal of Interactive Advertising, 14*(1), 11–23. https://doi.org/10.1080/15252019.2014.884480.

Eveland, W. P., Jr., & Dunwoody, S. (2000). Examining information processing on the World Wide Web using think aloud protocols. *Media Psychology, 2*(3), 219–244. https://doi.org/10.1207/S1532785XMEP0203_2.

Eveland, W. P., Jr., & Dunwoody, S. (2001). Applying research on the uses and cognitive effects of hypermedia to the study of the World Wide Web. *Annals of the International Communication Association, 25*(1), 79–113. https://doi.org/10.1080/23808985.2001.11679001.

Gil de Zúñiga, H., Garcia-Perdomo, V., & McGregor, S. C. (2015). What is second screening? Exploring motivations of second screen use and its effect on online political participation. *Journal of Communication, 65*(5), 793–815, 10.1111/jcom.12174.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. New York: Guilford Press.

Hendriks Vettehen, P. H., Nuijten, K., & Peeters, A. (2008). Explaining effects of sensationalism on liking of television news stories: The role of emotional arousal. *Communication Research, 35*(3), 319–338. https://doi.org/10.1177/0093650208315960.

Hoffman, D. L., & Novak, T. P. (2009). Flow online: Lessons learned and future prospects. *Journal of Interactive Marketing, 23*(1), 23–34. https://doi.org/10.1016/j.intmar.2008.10.003.

Horning, M. A. (2017). Interacting with news: Exploring the effects of modality and perceived responsiveness and control on news source credibility and enjoyment among second screen viewers. *Computers in Human Behavior, 73*, 273–283. https://doi.org/10.1016/j.chb.2017.03.023.

Huang, M. (2006). Flow, enduring and situational involvement in the web environment: A tripartite second-order examination. *Psychology and Marketing, 23*(5), 383–411. https://doi.org/10.1002/mar.20118.

Hwang, M.-Y., Hong, J.-C., Cheng, H.-Y., Peng, Y.-C., & Wu, N.-C. (2013). Gender differences in cognitive load and competition anxiety affect 6th grade students' attitude toward playing and intention to play at a sequential or synchronous game. *Computers & Education, 60*(1), 254–263. https://doi.org/10.1016/j.compedu.2012.06.014.

Hwang, Y., Kim, H., & Jeong, S. H. (2014). Why do media users multitask?: Motives for general, medium-specific, and content-specific types of multitasking. *Computers in Human Behavior, 36*, 542–548. https://doi.org/10.1016/j.compedu.2012.06.014.

Jeong, S., & Fishbein, M. (2007). Predictors of multitasking with media: Media factors and audience factors. *Media Psychology, 10*(3), 364–384. https://doi.org/10.1080/15213260701532948.

Jeong, S. H., & Hwang, Y. (2012). Does multitasking increase or decrease persuasion? Effects of multitasking on comprehension and counterarguing. *Journal of Communication, 62*(4), 571–587. https://doi.org/10.1111/j.1460-2466.2012.01659.x.

Jeong, S. H., & Hwang, Y. (2016). Media multitasking effects on cognitive vs. attitudinal outcomes: A meta-analysis. *Human Communication Research, 42*(4), 599–618. https://doi.org/10.1111/hcre.12089.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. *Applied Cognitive Psychology, 13*(4), 351–371. https://doi.org/10.1002/(SICI)1099-0720(199908)13:4<351:AID-ACP589>3.0.CO;2–6.

Kleemans, M. (2013). *Arousing television news: Concept, causes, & consequences*. Nijmegen: Radboud University.

Kleemans, M., Hendriks Vettehen, P., Eisinga, R., & Beentjes, J. W. (2014). Enjoyment of arousing television news: The role of age and sensation seeking. *Communications, 39*(1), 89–99. https://doi.org/10.1515/commun-2014-0006.

Kononova, A., & Chiang, Y. H. (2015). Why do we multitask with media? Predictors of media multitasking among Internet users in the United States and Taiwan. *Computers in Human Behavior, 50*, 31–41. https://doi.org/10.1016/j.chb.2015.03.052.

Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of Communication, 50*(1), 46–70. https://doi.org/10.1111/j.1460-2466.2000.tb02833.x.

Lang, A., & Chrzan, J. (2015). Media Multitasking: Good, bad, or ugly? *Annals of the International Communication Association, 39*(1), 99–128. https://doi.org/10.1080/23808985.2015.11679173.

Lee, H. J., & Andrejevic, M. (2013). Second-screen theory: From the democratic surround to the digital enclosure. In J. Holt, & K. Sanson (Eds.), *Connected viewing: Selling, streaming, and sharing media in the digital era* (pp. 40–61). New York: Taylor & Francis. https://doi.org/10.4324/9780203067994.

Lochrie, M., & Coulton, P. (2012). Sharing the viewing experience through second screens. In *Proceedings of the 10th European conference on interactive TV and video, July 4-6, 2012* (pp. 199–202). Berlin, Germany: New York: ACM. https://doi.org/10.1145/2325616.2325655.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist, 38*(1), 43–52. https://doi.org/10.1207/S15326985EP3801_6.

Mayer, R. E., Moreno, R., Boire, M., & Vagge, S. (1999). Maximizing constructivist learning from multimedia communications by minimizing cognitive load. *Journal of Educational Psychology, 91*(4), 638. https://doi.org/10.1037/0022-0663.91.4.638.

Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. Cambridge: MIT Press.

Moreno, R., & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology, 91*(2), 358. https://doi.org/10.1037/0022-0663.91.2.358.

Nielsen Company. (2013). *Action figures: How second screens are transforming TV viewing*. Retrieved from: http://www.nielsen.com/us/en/insights/news/2013/action-figures-how-second-screens-are-transforming-tv-viewing.html.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist, 38*(1), 1–4. https://doi.org/10.1207/S15326985EP3801_1.

Paas, F., Tuovinen, J. E., Tabbers, H., & Van Gerven, P. W. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist, 38*(1), 63–71. https://doi.org/10.1207/S15326985EP3801_8.

Paas, F. G., Van Merriënboer, J. J., & Adam, J. J. (1994). Measurement of cognitive load in instructional research. *Perceptual & Motor Skills, 79*(1), 419–430. https://doi.org/10.2466/pms.1994.79.1.419.

R Core Team. (2016). *A language and environment for statistical computing*. Vienna, Austria, 2014.

Rosseel, Y. (2012). *Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA)*. Ghent, Belgium: Ghent University.

Salvucci, D. D., & Taatgen, N. A. (2008). Threaded cognition: An integrated theory of concurrent multitasking. *Psychological Review, 115*(1), 101–130. https://doi.org/10.1037/0033-295X.115.1.101.

Schmeck, A., Opfermann, M., van Gog, T., Paas, F., & Leutner, D. (2015). Measuring cognitive load with subjective rating scales during problem solving: Differences

between immediate and delayed ratings. *Instructional Science, 43*(1), 93–114. https://doi.org/10.1007/s11251-014-9328-3.
Shim, H., Shin, E., & Lim, S. (2017). What makes us two-screen users? The effects of two- screen viewing motivation and psychological traits on social interactions. *Computers in Human Behavior, 75*, 339–346. https://doi.org/10.1016/j.chb.2017.05.019.
Statista. (2016). *Most popular activities to simultaneously use mobile phone with according to second screen users in the United States in June 2016*. Retrieved on May, 31, 2017, from https://www.statista.com/statistics/658396/us-second-screen-usage-environments/.
Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*(4), 295–312. https://doi.org/10.1016/0959-4752(94)90003-5.
Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review, 22*(2), 123–138. https://doi.org/10.1007/s10648-010-9128-5.
Sweller, J., Van Merrienboer, J. J., & Paas, F. G. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*(3), 251–296. https://doi.org/10.1023/A:1022193728205.
Van Cauwenberge, A., Schaap, G., & Van Roy, R. (2014). "TV no longer commands our full attention": Effects of second-screen viewing and task relevance on cognitive load and learning from news. *Computers in Human Behavior, 38*, 100–109. https://doi.org/10.1016/j.chb.2014.05.021.
Van Merriënboer, J. J., & Ayres, P. (2005). Research on cognitive load theory and its design implications for e-learning. *Educational Technology Research & Development, 53*(3), 5–13. https://doi.org/10.1007/BF02504793.
Voorveld, H. A. M. (2011). Media multitasking and the effectiveness of combining online and radio advertising. *Computers in Human Behavior, 27*(6), 2200–2206. https://doi.org/10.1016/j.chb.2011.06.016.
Vorderer, P., Knobloch, S., & Schramm, H. (2001). Does entertainment suffer from interactivity? The impact of watching an interactive TV movie on viewers' experience of entertainment. *Media Psychology, 3*(4), 343–363. https://doi.org/10.1207/S1532785XMEP0304_03.
Wang, Z., Irwin, M., Cooper, C., & Srivastava, J. (2015). Multidimensions of media multitasking and adaptive media selection. *Human Communication Research, 41*(1), 102–127. https://doi.org/10.1111/hcre.12042.
Wang, Z., & Tchernev, J. M. (2012). The "myth" of media multitasking: Reciprocal dynamics of media multitasking, personal needs, and gratifications. *Journal of Communication, 62*(3), 493–513. https://doi.org/10.1111/j.1460-2466.2012.01641.x.
Webster, J. G., & Wang, T. Y. (1992). Structural determinants of exposure to television: The case of repeat viewing. *Journal of Broadcasting & Electronic Media, 36*(2), 125–136. https://doi.org/10.1080/08838159209364162.
Wickens, C. D. (2002). Multiple resources and performance prediction. *Theoretical Issues in Ergonomics Science, 3*(2), 159–177. https://doi.org/10.1080/14639220210123806.
Yoon, S., Choi, Y. K., & Song, S. (2011). When intrusive can be likable. *Journal of Advertising, 40*(2), 63–76. https://doi.org/10.2753/JOA0091-3367400205.
York, C. (2013). Overloaded by the news: Effects of news exposure and enjoyment on reporting information overload. *Communication Research Reports, 30*(4), 282–292. https://doi.org/10.1080/08824096.2013.836628.
Zhang, W., Jeong, S. H., & Fishbein, M. (2010). Situational factors competing for attention. *Journal of Media Psychology, 22*(1), 2–13. https://doi.org/10.1027/1864-1105/a000002.
Zillmann, D., & Bryant, J. (1985). *Selective exposure to communication*. New York: Routledge.