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If I choose when to switch: Heavy multitaskers remember online content better than light multitaskers when they have the freedom to multitask

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ABSTRACT

The present study explored the effects of switching between reading an online article and checking Facebook on recognition memory, moderated by polychronicity, or preference for multitasking. The results of the study indicated that participants recognized online information less efficiently when they were required to check Facebook (forced multitasking) and when they could choose to check Facebook if and when they wanted (voluntary multitasking) compared with the control, non-multitasking, condition. I.e., the opportunity to multitask interfered with the efficiency of online information processing as much as actual multitasking. Polychronicity was a significant moderator of the multitasking effects. Low polychronics were negatively affected by multitasking to a greater extent than high polychronics. Their article recognition levels were lower than those of high polychronics. Two recognition measures derived from the signal detection theory: recognition sensitivity and criterion bias, were used. The study indicated that forced and voluntary multitasking affected high and low polychronics differently. Low polychronics showed greater cognitive effort than high polychronics when they engaged in voluntary media multitasking, while the amount of cognitive resources allocated to processing increased in high polychronics in the non-multitasking (control) condition. When high polychronics did not have control over switching to Facebook (forced multitasking), their recognition of the online article content decreased. Theoretical, methodological, and managerial implications of the study are discussed.

1. Introduction

The growing use of the Internet and social media, such as Facebook (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015; Internet World Stats, 2015; Perrin, 2015), increased the need to study how individuals process information while performing multiple online activities. The new reality dictates that online information processing often happens at the presence of multiple online distracters (e.g., when multiple windows are open on a computer) (Yeykelis, Cummings, & Reeves, 2014), which can lead to frequent task switching and, as a result, poor cognitive outcomes. Several studies have indicated that multitasking with traditional media decreases comprehension of and memory for reading materials (e.g., Armstrong & Chung, 2000; Furnham, Gunter, & Peterson, 1994; Jeong & Hwang, 2012; Pool, Koolstra, & van der Voort, 2003). The increasing rates of multitasking with new devices and media, such as Facebook, especially among young adults and students and especially in learning environments, calls for further investigation of multitasking effects on cognition (Foehr, 2006; Fried, 2008; Fulton, Schweitzer, Scharff, & Boleng, 2011; Hembrooke & Gay, 2003; Jones & Madden, 2002; Judd, 2014; Kononova & Yuan, 2016; Kononova, Zasorina, Diveeva, Kokoeva, & Chelokyan, 2014; Levine, Waite, & Bowman, 2007; Lin, Robertson, & Lee, 2009; Morpace Marketing & Consulting, 2010).

Applying the limited capacity of information processing approach (Kahneman, 1973; Lang, 2000, 2006a, 2006b) and the signal detection theory (Macmillan & Creelman, 1991; Shapiro, 1994), we explored the effects of checking Facebook during an online reading task on recognition memory for the reading materials moderated by the preference for multitasking, or polychronicity (Lindquist & Kaufman-Scarborough, 2007; Poposki & Oswald, 2010; Poposki, Oswald, & Brou, 2009).

The practical value of this study is in determining the effective

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ways of information processing in the online environment. The present research is also significant from the theoretical and methodological standpoint. It contributes to the growing body of literature about individual psychological differences that moderate the effects of media multitasking on cognition. Previous research has not provided consistent evidence about the effects of polychronicity on cognitive outcomes in multitasking situations (Brasel & Gips, 2011; Ophir, Nass, & Wagner, 2009; Sanderson, Bruk-Lee, Viswesvaran, Gutierrez, & Kantrowitz, 2013; Zhang, Goonetilleke, Plocher, & Liang, 2005). The question remains whether individuals who score high on polychronicity ("high polychronics" later in text) perform cognitive tasks better or worse than those who score lower ("low polychronics" later in text) when they multitask.

Past research in the area of media multitasking has predominantly used recognition accuracy measures based on forced-choice questions. We employed two other recognition measures, sensitivity and criterion bias, derived from the signal detection theory (SDT later in text) to determine if recognition outcomes for low and high polychronics in different multitasking conditions depend on actual content familiarity or rather on decision criteria that individuals adopt to judge content familiarity (Fox, 2004; Macmillan & Creelman, 1991; Shapiro, 1994).

Furthermore, the majority of previous experimental studies of media multitasking effects manipulated multitasking in a controlled manner where multitasking situation was forced on participants. Very few studies stated that they "encouraged" participants to multitask during an experiment (e.g., Fried, 2008; Hembrooke & Gay, 2003). This has posed a concern about the external validity of previous studies. To address this problem, we compared the effects produced by forced multitasking (checking Facebook at certain times) with the effects of voluntary multitasking (participants checked Facebook if they wanted and whenever they wanted).

2. Literature review

2.1. Limited capacity and media multitasking

Capacity theories that were developed in cognitive psychology more than half a century ago suggest that individuals have limited cognitive resources and cannot perform a cognitive task efficiently when they combine it with another cognitively demanding activity (Kahneman, 1973; Lang, 2000, 2006a, 2006b). Although humans have relative freedom in allocating their "capacity", "effort", or "attention" to various stimuli, they only operate a fixed amount of this abstract cognitive resource. This puts a limit on how much information from a task can be processed, how many activities can be performed concurrently, and how well the tasks are performed (Kahneman, 1973).

The Limited Capacity Model of Motivated Mediated Message Processing (LC4MP) is built on the same assumption that cognitive resources are restricted (Lang, 2000, 2006a, 2006b). Similar to early work in cognitive psychology that suggests that mental activity often balances two components: information input specific to a cognitive structure and capacity to process (Kahneman, 1973), the LC4MP proposes a continuous interaction between mediated messages and message content and structural features with human emotional and cognitive systems (Lang, 2006a, 2006b). One of the assumptions that sets this model aside from the large body of capacity literature is related to its focus on mediated communication. The LC4MP explains the effects of complex mediated messages that consist of "variably redundant streams of information" that can be perceived with multiple human senses (p. 559, Lang, 2006a, 2006b).

Media multitasking can create situations in which people are unable to effectively distribute their limited cognitive resources to process mediated information (Jeong, Hwang, & Finshbein, 2010). For example, background television, video, and music negatively affect the processing of textual information (Armstrong & Chung, 2000; Armstrong, Boriarsky, & Mares, 1991; Furnham & Bradley, 1997; Furnham et al., 1994; Lin et al., 2009); combining media use with homework increases the time needed to complete the homework, leads to worse homework performance, and results in poor recognition of TV messages (Bowman, Levine, Waite, & Gendron, 2010; Junco & Cotten, 2011; Pool et al., 2003; Pool, van der Voort, Bentjes, & Koolstra, 2000; Zhang, Jeong, & Fishbein, 2010); and multitasking with media impairs phonological and visual working memory functions (Armstrong & Sopory, 1997; Vega, McCracken, Nass, & Labs, 2008).

Multitasking with new digital technologies and its deleterious effects on cognition have been widely studied in the context of education and learning. Hembrooke and Gay (2003) found that having laptops on and engaging in media multitasking during lectures impaired students' recognition memory, measured with multiple-choice questions, and recall of lecture content. Fulton et al. (2011) have shown that even when information about the primacy of a learning task was clearly communicated to students, multitasking with email and Facebook in class significantly reduced students' performance on a quiz that contained forced-choice questions. Sana, Weston, and Cepeda (2012) asked participants to perform online tasks that mimicked typical student multitasking activities during lectures. Multitasking with Google, YouTube, and Facebook inhibited recognition memory and knowledge application. Students indicated poor performance when multitasking with Facebook and MSN messenger in a real-time university lecture (Wood et al., 2012). It has been argued that Facebook is more distracting than less dynamic platforms because it allows users to perform a variety of engaging activities such as browsing pictures, chatting, playing games, posting status updates, and other (Junco & Cotten, 2011; Nosko, Wood, & Molema, 2010; Wood et al., 2012). Even when students did not actively engage in multitasking, they reported that other students' laptops used in class were perceived as a distraction (Fried, 2008; Sana et al., 2012).

2.2. Encoding, recognition, and the signal detection theory

In order to successfully process mediated information, individuals must have cognitive resources available for allocation (Lang, 2000). Cognitive resources are typically allocated in a controlled or automatic manner to maintain three memory subprocesses that occur continuously and simultaneously (Lang, 2000, 2006a, 2006b; Schneider & Chein, 2003). These processes are encoding, storage, and retrieval (Baddeley, 2006; Lang, 2000, 2006a, 2006b). Encoding occurs during the initial stage of processing and refers to the registration of selected relevant or novel incoming information in memory (Lang, 2000, 2006a, 2006b). During encoding, information from selected stimuli "enters" a person's mind through sensory receptors (i.e., eyes, ears, nose, mouth, skin) (Eysenck, 1993). Encoded information can be stored in long-term memory and recalled later. Storage refers to linking bits of encoded information with information items previously kept in memory. Retrieval occurs when previously stored information is activated to make sense of incoming information or to perform a certain task (Lang, 2000, 2006a, 2006b). As encoding can determine how well incoming mediated information is stored and later retrieved (Lang, 2000, 2006a, 2006b), we focused on this important memory subprocess.

Encoding is commonly measured by recognition tests (Baddeley, 2003; Lang, 2000, 2006a, 2006b). The standard measure of encoding is recognition accuracy, or the percentage of correct