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Media multitasking predicts video-recorded lecture learning performance through mind wandering tendencies

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ABSTRACT

Media multitasking behaviors are on the rise globally. This phenomenon extends to academic settings, and has implications for education that is predicated on computer-assisted technology, which may be a source of distractibility for, especially, heavy media multitaskers. We hypothesized that habitual media multitasking correlates negatively with video-recorded lecture learning performance, with mind wandering mediating this association. Eighty-one participants from the National University of Singapore first completed a media multitasking survey (Loh & Kanai, 2014; Ophir et al., 2009). They then studied *Coursera* video-recorded lectures, during which their mind wandering tendencies were assessed using direct probes. Finally, participants attempted a test relating to what they have studied. Four regression models were built to analyse the data, and revealed evidence that supported the present hypothesis, even after we controlled for phenomenological variables relating to learning (i.e., anxiety, mental fatigue, and prior subject knowledge). Implications and future directions are discussed.

1. Introduction

Modern generations, owing to the ubiquity of portable and multi-functional Internet technologies, are engaging in unprecedented levels of media multitasking, which is broadly defined as the concurrent consumption of multiple media forms (Carrier, Cheever, Rosen, Benitez, & Chang, 2009; Rideout, Foehr, & Roberts, 2010). According to a recent review paper published in *The Neuroscientist* (Loh & Kanai, 2015), increased habitual media multitasking activity is associated with higher distractibility and decreased executive control. Specifically, individuals who engage in heavier media multitasking (HMMs) experience higher general distractibility (Waite, Levine, & Bowman, 2009) and more attention lapses in everyday life (Ralph, Thomson, Cheyne, & Smilek, 2014). Compared to light media-multitaskers (LMMs), HMMs are less able to exercise top-down control to suppress the processing of task-irrelevant information (Cain & Mitroff, 2011; Lui & Wong, 2012; Ophir et al., 2009). Loh and Kanai (2014) recently reported a biological link between media multitasking and executive control, which corroborated previous findings. Specifically, the study revealed that media multitasking negatively correlated with regional gray matter in the anterior cingulate cortex (ACC), a crucial node in the executive control network.

Pertinent to our research are studies which found media multitasking behaviors to be prevalent in such academic settings as lecture theatres and classrooms (Hembrooke & Gay, 2003; Jacobsen & Forste, 2011; Tindell & Bohlander, 2012) and associated with poorer learning (Wood et al., 2012) and academic grades (Clayson & Hayley, 2012). This fast growing body of work is particularly relevant in light of how the educational landscape is changing today. Education has traditionally revolved around a 'stand-and-deliver' pedagogical strategy, which is quickly becoming supplemented and increasingly substituted by newer models that have evolved in tandem with modern-day technological innovations and developments (see Khan, 2012 for a detailed discussion). Students can now receive education at the convenience and in the comfort of their homes, owing to the learning opportunities afforded by the Internet; online learning platforms, such as *Coursera*, *EdX*, and *Khan Academy*, host massive open online courses (MOOCs) that are accessible by learners globally.

Clearly, learners today enjoy access to a wide range of learning resources, and much flexibility to learn at their own preferred pace. However, it is important to note that successful online learning

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hinges heavily on the learner's ability to exert executive control – resist mind wandering and keep one's focus – whilst learning autonomously. According to McMillan, Kaufman, and Singer (2013), the concept of mind wandering relates to the "thoughts and images that arise when attention drifts away from external tasks and perceptual input toward a more private, internal stream of consciousness" (p. 1). Until only recently, the influence of mind wandering in educational settings – traditional classrooms as well as online learning environments – has been characterized as "under-recognized" (Smallwood, Fishman, & Schooler, 2007; see, also, Szpunar, Moulton, & Schacter, 2013b). This characterization has motivated both theoretical discussions and empirical investigations targeting possible linkages between mind wandering and education. Central to the present research are recent studies which have shown that mind wandering occurs frequently during video-recorded learning and is, in fact, associated with decreased learning of the educational materials presented (Risko, Buchanan, Medimorec, & Kingstone, 2013, 2012; Szpunar, Khan, & Schacter, 2013a). Increased mind wandering is, too, associated with higher general distractibility (Forster & Lavie, 2013) and a reduced ability to exert control over automatic thoughts (McVay and Kane, 2010). These findings, taken together, suggest that habitual media multitasking could predict the extent of success in video-recorded lecture learning, taking into account how much mind wandering had occurred during learning.

1.1. The present study

This research was conceived primarily to investigate the association between habitual media multitasking and video lecture lecture learning performance that is potentially mediated by learners' mind wandering tendencies. To test this hypothesis, we adopted the media multitasking index (MMI; Ophir, Nass, & Wagner, 2009) as a measure of habitual media multitasking activity. The MMI provided a reliable self-reported estimate of an individual's concurrent usage of different media types and had been used extensively across studies (e.g., Cain & Mitroff, 2011; Loh & Kanai, 2014; Yap & Lim, 2013). Participants viewed *Coursera* video-recorded lectures, and were subsequently tested on the lecture content as a way of measuring their learning performance.

Whereas previous media multitasking studies (e.g., Ralph et al., 2014) measured distractibility by collecting mind wandering self-reports, here we additionally tracked actual mind wandering events by administering direct probes at random time points (see Smallwood et al., 2007) during video lecture viewing (see Method section for details). We aim, in so doing, to make a side contribution by correlating, thereby validating, the self-report measures. Post-learning phenomenological ratings were recorded to provide further insights into participants' subjective video learning experiences. We expected habitual media multitasking, as evidenced by higher MMI scores, to be associated with poorer video learning test scores, with increased distractibility, as evidenced by participants' mind wandering tendencies, mediating this association. We also explored associations between our main variables (MMI scores, mind wandering scores, and test scores) and the post-learning phenomenological ratings.

2. Method

2.1. Participants

Eighty-one healthy undergraduate students [mean age = 20.93 (SD = 1.80); 49 were female] from the [National University of Singapore] participated in the current study. Forty-five participants received credits to fulfil an introductory psychology course requirement, whereas the other 36 participants received $10 cash reimbursement.

2.2. Materials

The modified Media Multitasking Questionnaire (Loh & Kanai, 2014) was adopted in its entirety. In this questionnaire, participants first reported the total number of hours per week they spent consuming 12 common media types: Print media, television, computer-based videos, music, mobile or telephone voice calls, online instant messaging, Short Messaging Service (SMS) messaging, web browsing, social networking sites, computer, video or mobile games and other computer-based applications. Next, via a matrix, the participants indicated the degree to which they would, while engaged in one media form as a primary activity, concurrently use other forms of media (1 "Never", 2 "A little of the time", 3 "Some of the time", or 4 "Most of the time"). Based on these responses, the media multitasking index (MMI) score for each participant was computed via the original mathematical formula documented in Ophir et al. (2009).

Participants viewed the video-recorded lectures on either a 24-inch color monitor of a Dell desktop computer or a 20-inch Fujitsu laptop computer. They were provided with standard Sony headphones; auditory output volume was adjusted to a comfortable listening level. The lecture videos were obtained from *Coursera*, a popular online learning platform, with permission from both the host provider and the respective course lecturers. The original video clips were edited and concatenated using iMovie software (Apple Inc.). Two different lecture videos were prepared: Video 1 was on geography, covering the topic of early Earth's sedimentary cycles and atmosphere, whereas Video 2 was on statistics, covering sampling and observational studies. The two lectures were controlled for both word count and duration (Video 1 contained 3028 words and lasted 18:28 min; Video 2 had 3063 words and spanned 18:15 min). 25 questions were developed for each video-recorded lecture video, along with answer keys and marking schemes for scoring participants' responses. Questions were designed to test the understanding of key concepts from the lectures (e.g., "What is the relation between a population and a sample?"), and responses were scored based on how accurate they were: one mark (correct), half a mark (partially correct), or zero marks (incorrect).

2.3. Procedure

Participants were, upon their arrival, provided with an overview of the study's proceedings. Informed written consent was obtained from all participants. Participants first filled out the media multitasking questionnaire at their own preferred pace. Following which, an important pre-lecture briefing was administered. Participants were told to learn the content of the video-recorded lecture as they normally would under a regular classroom setting. Each participant was assigned to an individual computer, and watched the lecture video whilst listening via headphones. This ensured that participants did not interact with or disturb one another. Participants were instructed not to take notes during the lecture.

Mind wandering was assessed via a direct-probing approach: At random points during the lecture, the experimenter rang a bell, which was to be taken literally as a question of whether their attention had strayed away from the lecture content at that moment in time (i.e., "Are you mind wandering?"). Upon hearing the bell, which was hidden from view, participants had to quickly write down a yes/no response on a blank piece of paper without pausing the lecture video. Participants were not told how many