Abstract

Research on media multitasking is troubled by ambiguous results, often comparing extreme groups of media multitasking behavior. This study investigated a potential non-linear correlation by using all data from the Media Multitasking Index and the modified card-sorting test to gain a comprehensive understanding of the relationship. Anticipating an inverse U-shaped correlation, the study employed a novel approach by using polynomial regression. A total of 161 participants were tested online via survey exchange sites. By comprehensively exploring the impact of media multitasking on cognitive flexibility, this study aimed to address various conflicting aspects of the current literature. However, no significant relationships were found, and underlying limitations were discussed to guide future research in this area.

Introduction

With the increased use of media technology and media multitasking (MM), there is a growing interest in the influence on our cognitions and behaviors (Carrier et al., 2009).

One of the first studies that researched MM as a trait was conducted by Ophir and colleagues (2009). In their paper, MM was defined as the simultaneous consumption of different streams of content through different forms of media. The present work examines media multitasking as defined by the Media Multitasking Index, a questionnaire devised by Ophir and colleagues in the course of their work. This questionnaire categorizes individuals into Heavy (HMMs), Light (LMMs), and Intermediate Media Multitasking Users (IMMs) based on standard deviations from the mean of the current sample. This approach has been maintained by subsequent media multitasking research to this day. Further explanations of the MMI will be provided in the methods section. A review of the effects of media multitasking on youth by Van der Schuur and colleagues (2015) found that MM was primarily investigated regarding three different aspects: cognitive control abilities, academic performance, and socioemotional function. In their review, the authors formulated two opposing hypotheses regarding the effects of MM on cognitive control: the scattered attention hypothesis and the trained attention hypothesis. The arguments supporting each one can be traced back to the discussion presented by Ophir and colleagues (2009). According to the scattered attention hypothesis, regular media multitasking leads to not only a “breadth-bias” toward media consumption but also a breadth-bias in cognitive control, which makes them susceptible to distractors. Conversely, the trained attention hypothesis argues that the ability to switch between tasks and focus on relevant stimuli can be developed through training. Since then, there has been evidence for either the scattered attention hypotheses (Kong et al., 2009; Ophir et al., 2009; Uncapher & Wagner, 2018; Van Der Schuur et al., 2015; Yap & Lim, 2013) or the trained attention hypothesis (Alzahabi & Becker, 2013; Ophir et al., 2009; Van Der Schuur et al., 2015). However, not all studies have found significant relationships; for instance, Edwards and Shin (2017) and Seddon et al. (2018) reported no significant effects of media multitasking on cognitive control.

**Media Multitasking and Cognitive Control**

Cognitive control is separated into three different aspects: cognitive flexibility, working memory, and inhibitory control (Davidson et al., 2006). Working memory is the ability to temporarily hold and manipulate information necessary for cognitive tasks, allowing individuals to process and use relevant information (Baddeley). Cognitive flexibility is the competence to adapt and switch between different cognitive processes or tasks. Inhibitory control is the ability to suppress or override automatic responses, impulses, or distractions, allowing individuals to focus on relevant information and make intentional, goal-directed decisions (Diamon). Every aspect has its unique relationship with MM (Uncapher & Wagner, 2018). A recent meta-analysis by Kong and colleagues (2023), which examined the effect of MM on cognitive control while considering the different subsets as moderators, found a significant negative impact. The authors also found a significant moderating effect of type for working memory and inhibitory control, while being non-significant for cognitive flexibility. Other reviews, however, did not come to the same decisive conclusions (Kobayashi et al., 2020; Uncapher & Wagner, 2018). While the research regarding cognitive flexibility argues for a non-significant relationship, there are considerations that these findings may result from comparing extreme groups. For example, some research found that IMMs performed better than HMMs on tests of focused attention, suggesting a possible inverse U-shaped correlation between MM and components of cognitive control (Cardoso-Leite et al., 2016; Shin et al., 2020). Shin and colleagues (2020) demonstrated that IMMs outperformed both HMMs and LLMs on a more challenging variant of the n-back task, as opposed to the easier versions. Additionally, HMMs did not score significantly differently from LMMs, which aligns with the inverse U-shape hypothesis. To better understand the subtle differences influencing the effects of MM on cognitive flexibility, it is important to examine the full spectrum of MM behavior. Thus, this study explores the shape of the relationship between media multitasking and cognitive flexibility without excluding data based on MM index scores. This study postulates a non-linear correlation between MM and cognitive flexibility, and further, it postulates that the non-linear relationship follows an inverse u-shape.

significant difference in MMI scores between IMM and HMM or LMM, expecting higher focused attention scores for IMM. The correlation of the MMI is anticipated to follow an inverse-U pattern. Moreover, according to the latest findings of Kong and colleagues (2023), it is still expected that HMM score lower on the MMI than LMM, contributing to a comprehensive understanding of media multitasking effects. Regarding additional moderator variables the same study also looked at other possible moderator variables like age and gender for which they didn’t find a significant relevance.

The literature was especially vague regarding focused attention, a necessary component of inhibitory control to ignore distractors (Kobayashi et al., 2020), findings remain inconclusive, ranging from worse performance from HMM for focused attention (Ophir et al., 2009; Ralph et al., 2015; Yap & Lim, 2013) to no significant differences in performance (Baumgartner et al., 2014; Minear et al., 2013). Some research found that Intermediate Media Multitaskers (IMM) performed better than HMM on tests of focused attention, arguing for a possible inverse-U correlation between Media Multitasking and certain aspects of cognitive control, especially attention and inhibitory control (Cardoso-Leite et al., 2016; Shin et al., 2020). Shin and colleagues (2020), for example, demonstrated that IMM outperformed HMM in a more challenging variant of the n-back task, as opposed to the easier versions. Additionally, HMM did not differ from LMM. So even while Kong and colleagues (2023) found a negative effect they only compared HMM to LMM, as they didn’t include IMM. The authors themselves pointed out the limitations. To get a better understanding of the subtle differences that influence the effects of MM, it is of great importance to examine these relations. To examine this specific aspect of media multitasking on focused attention and to gather data about IMM, this study postulates a significant difference in MMI scores between IMM and HMM or LMM, expecting higher focused attention scores for IMM. The correlation of the MMI is anticipated to follow an inverse-U pattern. Moreover, according to the latest findings of Kong and colleagues (2023), it is still expected that HMM score lower on the MMI than LMM, contributing to a comprehensive understanding of media multitasking effects. Regarding additional moderator variables the same study also looked at other possible moderator variables like age and gender for which they didn’t find a significant relevance.

**Method**

The present study will compare the results of the MMI questionnaire with the results of another experiment which measures focused attention. As mentioned before, the MMI was developed by Ophir and colleagues (2009) and is a widely used method to inquire about the behaviour of media multitasking. Ophir and colleagues asked how much time participants spend with each medium in a week, for which they used 12 different media forms. The present study will use the media typology of Seddon and colleagues (2018), who adapted the media forms to more modern use of technology like the inclusion of browsing and posting on social media, thereby improving the diversity of media covered. For each primary media (all but texting, 11 in total), participants are asked to share how often they use the other forms of media simultaneously, through a matrix, which will be summed up as . With the number of hours per week and the total number of hours per week across all media forms the Index is formed:

The cut-off points for the different behaviour will be the lower and upper quantile, following the recommendations of Van Der Schuur and colleagues (2015) to ensure a standardization and comparability between different studies. The questionnaire will be administered digitally following the assessment of focused attention. A digital form seems suitable, since the participants will already be on the computer and for easier evaluation.

The focused attention measurement will be conducted as part of another study's experiment. The experiment is designed to study different variables on the perception and attention of participants, especially the ability to focus on a certain task while suppression the interference by distractors. Participants must detect the position of a target stimulus as they are shown either short-form or long-form media content, while also being distracted by abrupt onset stimuli. The target stimuli are shown in the last second of the video contents and participant will have to press a button according to the position of the target stimuli. The stimuli will be different geometrical shapes in grey and the shape of the target stimuli will be explained in the instructions. Some trails will have abrupt onset stimuli. Non-target shapes that appear a few milliseconds after the others. All separate conditions of the experiment will be treated as one condition by the present study. Regarding the limitations of the resource of a bachelor thesis, 60 participants will be collected through social media, personal contact, and as well as lab credits for the bachelor’s program in psychology. The targeted age range of participants will be between 18 to 25, bound by the necessities of the other experiments. The present study would not need to make this restriction on the age range, but it also won’t be expected to be a moderating factor (Kong et al., 2023). For good measure the questionnaire will still control for age and gender as possible moderator variables. Since normality and homogeneity of variance are expected (Ophir, 2009), the differences between IMM and HMM/LMM will be computed through a one-sided t-test, as it is commonly used to test if two groups come from different populations, with IMM having higher scores than HMM and LMM in inhibitory control, respectively. To control for an inverse-U correlation, the significance of a quadratic regression model fitted to the data will be tested using R (Version 4.3.1; R Core Team, 2022). The test location will be Liebiggasse 5, 1010 Vienna. Participants will be handed a declaration of consent which includes aim of the research, general information, possible dangers of participation and the information of freedom to leave the experiment at any point during the testing without consequences.

**Limitations**

While the use of the measurements of another experiment represents a highly economical use of resources, it does come with the possibility that either short-form or long-form content or the use of abrupt onset trails may act as a moderator between MM and focused attention, an area for which there is currently no existing literature. Furthermore, the number of participants will be very conservative of only 30 participants for each type of media content. To find differences between IMM and HMM/LMM, there would be a need for 310 participants per group or 620 in total. The sample size was computed using G\*Power (3.1.9.7) (Faul et al., 2009), with an expected effect of 0.2, a Power of 0.8 and an alpha level of 0.05 (Kong et al., 2023; Van Der Schuur et al., 2015). It also must be considered that even if a normal distribution can be expected, there is no foretelling how the sample will separate in their MM-Behaviour, or if they will have average MMI scores across all pertinent studies. Kobayashi and colleagues (2020), for example, found a lower MMI mean score in their sample as prior studies. A better approach would be to find volunteers based on their MM-Behaviour and then test them on focused attention.