Psychosocial Outcomes and Emotion Processing in Media Multitaskers

Author

Lee, Mindy

Published

2018-04

Thesis Type

Thesis (Professional Doctorate)

School

School of Applied Psychology

DOI

10.25904/1912/220

Psychosocial Outcomes and Emotion Processing in Media Multitaskers

Mindy Lee

BPsych(Hons)

School of Applied Psychology, Griffith University

Menzies Health Institute Queensland

Submitted in fulfilment of the requirements of the degree of Doctor of Philosophy (Clinical Psychology).

April, 2018

April 2018

Mindy Lee

ACKNOWLEDGEMENTS

I would like to give my heartfelt thanks to my supervisors, Karen and Glenda, who have assisted through this extraordinary journey of completing a PhD. Without your advice, input, and pep talks, this would not have been possible.

Thank you to all the participants who have given up their time and energy to complete lengthy surveys and experiments.

I want to express my appreciation to Samantha Tay, Sophie van Rooyen, Dr Bekki Green, and Dilara Asena for your incredible friendship and support throughout this process. I will always be grateful for your listening ears, faith, and humour. To all other friends and colleagues who I have crossed paths with, your words of encouragement have helped tremendously along the way.

A big thank you to my family, especially Mum and Dad. I am so lucky to be your child. All that I am is because of you. Your strength, even in adversity, inspires me every day and I could only hope to be as strong as you one day.

And finally, to my Love, thank you for being my sun. This win is for us.

ABSTRACT

Media multitasking refers to the simultaneous use of more than one media form (Ophir et al., 2009). This definition has sometimes been inclusive of using media while doing a non-media activity such as interacting with others (Xu et al., 2016). This research examined the relationship between media multitasking, psychosocial well-being and personality traits. Additionally, this research investigated media multitaskers' emotion processing on three established attention tasks.

Existing research has shown that media multitasking is associated with poorer psychological (Becker et al., 2013) and general well-being (Pea et al., 2013). A principle aim of the present research was to expand on the existing literature by exploring the link between media multitasking and a range of psychosocial well-being constructs including trait depression, trait anxiety, social anxiety, general well-being, and empathy. A link between media multitasking and personality traits has also been reported in the literature, however only a few traits have been examined to date (e.g., impulsivity, sensation seeking). One aim of the current research was to expand on this by exploring other personality traits such as the Big 5 (extraversion, agreeableness, conscientiousness, neuroticism, and openness) and narcissism. Therefore, the link between media multitasking and well-being has been reported, and the link between media multitasking and personality appears to be present as well. Yet, how these three variables might intertwine with each other has yet to be investigated.

In the present research, Study 1 examined the relationship between media multitasking, psychosocial well-being (trait depression, trait anxiety, social anxiety, general well-being, and empathy), and personality traits (Big 5 and narcissism) through an online survey. The study examined if media multitasking mediated the relationship between personality traits and psychosocial outcomes. Study 1 also investigated the specific association between using media while interacting with others, and how this behaviour

contributes to psychosocial well-being after controlling for personality variables. Study 2 was a word rating study that was necessary to generate comparable face and word stimuli sets that would be used in Study 3. This was needed because word databases have generally categorised words into positive and negative categories only, or have used words that may have subjective meaning attached to it (e.g., objects or occasions). Study 3 employed three well-established attention tasks: the dot-probe paradigm, visual search task, and attentional blink task. These tasks are designed to measure selective, spatial and temporal attention, respectively. Across the tasks, happy, angry and neutral faces and words were used. The primary research questions of interest were: (a) whether heavy media multitaskers perform worse on attention tasks compared to light and average media multitaskers; (b) whether different groups of media multitaskers have attentional biases towards specific emotions; and (c) whether the group differences are consistent across the three attention tasks.

Findings from Study 1 showed that higher levels of media multitasking were related to poorer levels of psychosocial well-being, in particular, trait depression, trait anxiety, general well-being, and empathy. Further analyses showed that media multitasking partially mediated a number of the relationships between personality traits and psychosocial well-being outcomes. Study 1 also found that using media while interacting with others was associated with higher levels of trait depression, trait anxiety, social anxiety, and lower levels of general well-being, and empathy. Whereas previous studies have found that heavy media multitasking is related to performance on several cognitive tasks such as task switching (Cardoso-Leite et al., 2016; Ophir et al., 2009), filtering (Cardoso-Leite et al., 2016; Ophir et al., 2009), and working memory tasks (Ralph & Smilek, 2017; Uncapher et al., 2016), findings from Study 3 showed a significant group difference on the dot-probe task in relation to emotion bias, but not on overall performance. There were no group differences found on the visual search and attentional blink tasks. Potential explanations for these unexpected findings are outlined and discussed. The overall performance on each task also produced results showing some biases towards emotions compared to neutral stimuli, but this was not consistent across all conditions nor across faces and word tasks. This was likely due to the use of subtle stimuli and task instructions which resulted in an inconsistency with previous research showing robust effects for emotional biases.

This research provides a better understanding of how an increasingly prevalent behaviour such as media multitasking can potentially contribute to people's well-being and cognitive performance. This has practical implications for the need to highlight cautionary use of multiple media forms concurrently, as it is currently increasingly encouraged or sometimes necessary in schools, workplaces, and homes.

STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

…………………………………………….

Mindy Lee

April, 2018

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

STATEMENT OF ETHICAL PROTOCOL

I confirm that ethical clearance was granted by the Griffith University Human Research Ethics Committee (GU Ref No: 2016/430, 2015/566, 2015/421, PSY/C2/14/HREC, PSY/33/15/HREC). I confirm that the research was conducted in accordance with the approved protocols.

…………………………………………….

Mindy Lee

April, 2018

ACKNOWLEDGEMENT OF PAPERS INCLUDED IN THIS THESIS

Included in this thesis is a paper in Chapter 3, which is co-authored with other researchers. This publication is in accordance with Section 9.1 of the Griffith University Code for the Responsible Conduct of Research ("Criteria for Authorship"), Section 5 of the Australian Code for the Responsible Conduct of Research, and Section 9.3 of the Griffith University Code ("Responsibilities of Researchers"). An acknowledgement of my contribution to the co-authored paper is outlined at the front of the relevant chapter with the publication status and bibliographic details (where relevant).

Mindy Lee, PhD Candidate

Karen Murphy, Principal Supervisor

Glenda Andrews, Associate Supervisor

CHAPTER 1: INTRODUCTION

The Prevalence of Media Multitasking in Today's Society

The influence of media multitasking has recently garnered more attention in the research community due to its increased prevalence in society. The aim of the research reported in this thesis is to expand on the current literature and investigate new areas of media multitasking research that have not been previously explored. Media multitasking refers to the use of more than one media form simultaneously (Ophir, Nass & Wagner, 2009). For example, using a computer while watching television, reading a book while listening to music, or talking on the phone while playing a video game. Some studies have also considered media multitasking to be defined as the use of media while engaging in a non-media activity (Xu, Wang & David, 2016). For example, texting while having a meal with someone or listening to music while exercising.

Given the increased accessibility of media forms and usage over a range of daily activities, it is not surprising that media multitasking is becoming an increasingly common occurrence amongst children, young adults, and even older adults (Rideout et al., 2010). Large-scale studies, such as the Kaiser Family Foundation study by Rideout et al., (2010) show significant increases in the concurrent use of different media in American youths aged between 8-18 years. They also found that more time spent media multitasking was associated with lower grades and lower levels of contentment, and that the modern youth packs the equivalent of 10 hours and 45 minutes worth of media content in a daily seven and a half hour media consumption time. This is similar to the amount of time an adult spends at work, except that it occurs daily instead of five days a week.

No large-scale study has examined overall media multitasking prevalence amongst adults, but reports have identified young adults as being the most connected among Internet users, with 88% going online (Madden, 2006). A recent study showed that most university students owned multiple devices and were motivated to media multitask so that they could know and achieve as much as possible, as well as to relieve boredom and habit (Stamenkovic, Dukic & Aleksic, 2018). Contrary to the belief that media multitasking is mainly undertaken by young people, this may not be the case, as shown in a more recent study of media multitasking amongst various age groups (Voorveld & van der Goot, 2013). The researchers found that teenagers (13 - 16 years) spent the most time media multitasking, followed by the oldest age group (50 – 65 years). The main difference was in the combinations and types of concurrent media use (Voorveld & van der Goot, 2013). Given that the prevalence of media multitasking has continued to increase, and is likely to continue increasing, this is an important area of research to understand how media multitasking could influence people's cognitive and socioemotional functioning.

The Current Research

Media multitasking is still a relatively new area of research that requires more investigation on the implications of engaging in this behaviour. This could inform whether a current trend in society of increasing use (Rideout et al., 2010) and dependence of media in educational settings, workplaces, and homes is healthy or detrimental to well-being. If the latter, then schools and workplaces may wish to promote media-free time or spaces, while individuals may also wish to incorporate these into their own lives and within social interactions. In the therapeutic setting, media multitasking could also be an aspect that therapists could identify as contributing to patients' well-being, thus potentially working to change these behaviours as an area of intervention. This research project explored the media multitasking phenomenon in two main ways. First, I wanted to investigate the relationship between media multitasking behaviours and psychosocial outcomes. Second, I wanted to find out whether there are emotion processing differences in media multitaskers. Three studies were designed at the outset to investigate three separate but interlinked aims: 1) to explore relationships between media multitasking, psychosocial outcomes, and personality traits 2) to produce a set of stimuli that are suitable for use on emotion attention tasks and 3) to investigate whether media multitasking groups process emotions differently on attention tasks. Together, these aims meet the overall goal of expanding on previous research and providing more insight into the relationship between media multitasking, well-being and attention to specific emotions (happy/angry)."

Study 1 addressed the first main question by conducting an online survey, which included a range of psychosocial and personality measures as well as a measure of media multitasking behaviour. Study 1 is covered in Chapter 2 and Chapter 3 includes a paper that has been submitted to a peer-reviewed journal. This paper focused on media use during face-to-face interaction and the associations with psychosocial outcomes. Chapter 4 explains the process of rating and selecting stimuli for use in Study 3. In my research project, I also explored emotional processing in individuals who engage in media multitasking to varying extents, with the aim of examining if these groups have biases towards specific emotions that are consistent across different types of attentional tasks. To address these questions, Study 3 used an experimental design comprising of three well-established attention tasks using emotional stimuli that were faces and words selected from Study 2. Chapter 5 provides a general overview of Study 3. Chapters 6, 7 and 8 feature the dot-probe, visual search, and attentional blink tasks used in Study 3, respectively. Refer to Figure 1.1 for an overview of the studies and research questions for this thesis. The final thesis chapter ties together findings from this research, discussing the connections between media multitasking, psychosocial outcomes and emotion processing, and directions for future research.

Psychosocial Outcomes and Emotion Processing in Media Multitaskers

Study 1 (Chapter 2 and 3)	**Study 2** (Chapter 4)	**Study 3** (Chapter 6, 7, and 8)
Purpose: To explore relationships between media multitasking, psychosocial well-being, and personality characteristics *Sample:* First year undergraduate students *Task:* Online survey *Measures:* MMI, MTSD-T, STAI-T, IAS, WBMMS, TEQ, BFI-10, NPI-16 *Analysis:* Correlational, regression and mediation analyses	*Purpose*: To rate and select emotional face and word stimuli for Study 3 *Sample:* First year undergraduate students *Analysis:* One way ANOVA	*Purpose*: To examine emotion processing in media multitaskers through attentional tasks *Sample:* Volunteer participants who engage in light, average, or heavy media multitasking *Tasks:* Dot-probe, visual search, attentional blink *Measures:* MMI, MTSD, STAI, *Analysis:* Mixed Factorial ANCOVA

Study 1	Study 3
Research Question 1: Is media multitasking associated with poorer psychosocial outcomes such as depression, anxiety, empathy, and general well-being? **Research Question 2:** Does media multitasking relate to personality characteristics, and does media multitasking mediate the relationship between personality and psychosocial outcomes? **Research Question 3:** Are there negative psychosocial outcomes for media use during face-to-face interaction, and does this behaviour contribute to poorer psychosocial outcomes after controlling for personality variables?	**Research Question 4:** Do heavy media multitaskers perform worse on attention tasks compared to light and average media multitaskers? **Research Question 5:** Do different groups of media multitaskers have attentional biases towards specific emotions? **Research Question 6:** Are these group differences, if any, consistent across three established attention tasks?

Figure 1.1. Overview of the three empirical studies and the research questions addressed in each. Media Multitasking Index (MMI), Maryland Trait-State Depression (MTSD), State-Trait Anxiety Inventory (STAI), Interaction Anxiousness Scale (IAS), Well-being Manifestations Measure Scale (WBMMS), Toronto Empathy Questionnaire (TEQ), Big Five Inventory (BFI), Narcissistic Personality Inventory (NPI)

In the remainder of this chapter, I first outline the threaded cognition model, a theoretical framework accounting for multitasking behaviour. I then review studies that have examined the relationship between media multitasking and cognitive performance. I also review studies that have investigated how media multitasking might contribute to psychosocial well-being. These were reviewed with relevance to the current thesis and its aims.

Threaded Cognition Model

The threaded cognition model was developed by Salvucci and Taatgen (2008) and accounts for multitasking behaviours. In this model, it is assumed that cognitive modules can operate in parallel, however, a single module can only be used for a single task. This model suggests that threads are coordinated by a serial procedural resource that combines inputs from other resources and initiates new processing on these resources. A thread will take the resource it needs if the resource is available, and let go of the resource when it is no longer needed. The modules are proposed in the following sequence. First, a cognitive resource (e.g., visual, auditory, motor control) module perceives the stimulus input. Procedural memory is then represented by production rules, and are translated into actions. Declarative memory is the existing knowledge of facts and events that is used to determine production rules, which are contingencies for action, and can then determine, for example, whether a stimulus is related or unrelated to the task at hand. The imaginal module then acts as a limited working memory store, and will be needed when a thread has to keep a problem state in mind. Due to each cognitive thread having its own control structure that runs independently from other threads, the theory explains how people can flexibly combine previously unrelated tasks, or learn tasks in isolation then perform them together later.

According to the threaded cognition model, media multitasking would therefore occur in the following manner. For example, an engaging in watching TV and talking on the phone at the same time would involve two separate threads. Watching TV requires visual and auditory resources, while talking on the phone would require auditory and verbal resources. Therefore, both threads will take turns using the auditory resource as needed and switch between both activities. If attention is required for one activity (e.g., the friend on the phone is in distress), declarative memory would determine that the individual needs to listen to the friend rather than what is being said on TV, and procedural memory would redirect the individual to attend to the friend. Since the auditory resource is being used by the phone thread, the individual would only be able to attend to visual information from the TV and not auditory information. However, the plot of the TV show would still remain in the imaginal module so that if reuptake of the activity occurs shortly after, the individual would be able to remember what they had watched so far. Given that this switching of resource use when there are multiple goals can predict interference (Borst & Taatgen, 2007; Taatgen et al., 2009), it is likely that media multitasking would be linked to issues such as reduced task performance.

Heavy Media Multitasking is Associated with Impaired Cognitive Performance

Ophir et al. (2009) developed the Media Multitasking Index (MMI) to categorize groups of high (HMM) and low media multitaskers (LMM) in a sample of university students. The MMI is a self-report measure of the amount of time spent using one form of media with another form of media (e.g., watching TV while texting). High and low cutoff scores were defined as one standard deviation above and below the mean on the MMI. The relationship between media multitasking and cognitive control was examined using filtering and response inhibition tasks and task-switching performance. In the filtering test, participants viewed two consecutive displays of rectangles and had to indicate whether the target (red) rectangle had changed orientation from the first display to the second. Distractors were blue rectangles, and displays could have 0, 2, 4 or 6 distractors. HMM performance was adversely affected by number of distractors, while LMM were unaffected by distractors. In the AX-CPT variant of the Continuous Performance Task, participants viewed cue-probe pairs of letters and respond ‘yes’ when they saw the target cue-probe pair (AX) appear in succession. They had to respond ‘no’ to all other letter combinations (e.g., AY, BX). In addition, a version using distractor letters of a different colour was administered. The distractors intervened between the cue and probe, but participants were told to ignore these letters. When no distractor was present, HMM and LMM had comparable response times. However, when distractors were present, HMM had much slower response times than LMM. The two and three-back tasks examined ability to monitor and update multiple representations in working memory. Participants were presented with sequences of letters, and when a letter was presented, participants had to indicate whether the current letter matched the letter presented two (two-back task) or three (three-back task) positions earlier in the sequence. HMM showed a significantly greater decrease in performance from the two to three-back tasks compared to LMM. This became more prominent over time, as more irrelevant letters accumulated in working memory. For task switching, participants were shown one of two cues (NUMBER or LETTER), followed by digit-letter pair (e.g., 2b or b2). Participants had to classify the number (even or odd) or letter (vowel or consonant), depending on the cue. Results indicated that HMM showed poorer task-switching performance compared to LMM.

Based on these results Ophir et al. (2009) proposed that HMM had greater difficulty filtering out irrelevant distractors from the environment (filtering and AX-CPT tasks), were less likely to ignore irrelevant representations in memory (two and three-back tasks), and were less effective in suppressing the activation of irrelevant task sets (task-switching) than LMM. It was suggested that HMM had a tendency for bottom-up attentional control while LMM are more biased towards top-down attentional control. The bottom-up attentional control leads to a breadth-biased way of processing information in HMM, who are more likely to respond to information outside the required task, sacrificing performance on the required task (Ophir et al., 2009). In contrast, top-down attentional control in LMM means that they may find it easier to focus on the single immediate task even when distractions are present.

One study explored the link between media multitasking behaviours, playing action video games, and cognitive performance (Cardoso-Leite et al., 2016). Replicating Ophir et al. (2009), the AX-continuous performance, *n*-back, task switching, and filtering tasks were used to measure different facets of attention and cognition. The HMM and LMM cut-offs used were the same as Ophir et al. but an intermediate media multitasking group was also formed with those who scored between these extremes. HMM performed worse than LMM on the AX-CP, three-back, and filtering tasks, but no differences between groups were found for task switching. In contrast to Ophir et al., the observed deficits were not specific to the presence of distractors. Rather it was more of a general nature in terms of slower speed and less accuracy in HMM compared to other groups. The intermediate media multitasking group performed better than HMM and LMM in the *n*-back and filtering tasks, contradicting the prediction that intermediate media multitaskers would perform at a level that was between HMM and LMM. In this study, action video game players within each of the three groups were classified as those who played action games for more than five hours per week. In the intermediate group, action video game players outperformed non-gamers across all four tasks. This did not occur in the HMM and LMM groups, which may be an indication that the potential benefits of playing action video games does not protect against or enhance the effects of heavy or light media multitasking respectively (Cardoso-Leite et al., 2016).

However, findings from Baumgartner et al. (2014) only partially supported the notion that media multitasking is associated with cognitive deficits. Media multitasking was measured using an adapted version of the MMI, which included media and non-media activities. The study collected both self-reported measures of everyday executive functioning, and performance on executive functioning tasks. Executive functions are a set of mental skills that allow for the planning, organisation and completion of tasks. Working memory, inhibition and shifting/task switching was assessed using a Digit Span Task, Eriksen Flanker Task, and Dots-Triangles Task, respectively. Results showed that higher levels of media multitasking was related to lower scores on all three facets of self-reported executive functioning. Higher levels of media multitasking was also related to poorer performance on the inhibition task. However, no relationship was found between media multitasking and performance on the working memory and shifting tasks. Other studies have only investigated specific areas of cognitive performance such as working memory and contrasted these findings.

Working memory in media multitaskers

Another aspect of cognitive abilities has also been examined by Ralph and Smilek (2017) using the *n*-back to assess working memory. They found that HMM were less attentive than LMM during the task, therefore having more omissions (i.e., no response was provided). HMM also had more self-reported random responses at various times throughout the task. These imply lack of attention and focus on a task and the tendency to disengage, which could contribute to poorer encoding of information into working memory. In contrast to other studies, Ralph and Smilek (2017) considered media multitasking as a continuous variable rather than using HMM and LMM groups, arguing that it was wasteful to discard data from intermediate media multitaskers given that MMI scores are reasonably normally distributed.

The results from Ralph and Smilek (2017) were further supported by Uncapher, Thieu and Wagner (2016) using a different type of task to assess long-term and working memory in media multitaskers. The MMI was used to measure media multitasking, but cut-off scores used for HMM (mean MMI = 6.92) and LMM (mean MMI = 2.19) groups were not provided. The researchers asked participants to complete cognitive tasks including visual working memory tasks and recognition memory tasks. The working memory tasks required participants to remember the orientation of rectangles or objects, while ignoring other distractor rectangles or objects. After a delay period, participants determined whether the orientation of the target had changed. Next, participants performed in a recognition memory task with object stimuli from the previous working memory test mixed with new object stimuli. HMM were found to perform more poorly than LMM on both working memory and long-term memory tasks regardless of whether distractors were present or not. HMM were observed to have difficulty with discriminability rather than a decision bias, indicating that the amount or accuracy of information held in mind was poorer than LMM. Working memory abilities was also found to be a predictor of long-term memory performance (Uncapher et al., 2016).

Although this new study did not compare media multitasking groups, Ralph et al. (2018) investigated the awareness people had on their task performance on the *n*-back while engaging in media multitasking, and the extent to which they modulate media multitasking behaviour to in an attempt to increase task performance. It was found that people were sensitive to the effect media multitasking was having on their primary task performance and were more likely to modulate (switch off the concurrent video) media multitasking behaviour on a high-demand task than a low-demand task.

The studies reviewed in this section indicate that media multitasking was associated with cognitive impairment in a few different areas such as task-switching, working memory, filtering. However, not all the evidence supports this. The next section will review studies that have found contrasting results to those that have been mentioned so far.

Media Multitasking is Associated with Cognitive Performance Benefits

In a study comparing task-switching performance and dual-task performance in HMM and LMM, Alzahabi and Becker (2013) also used the MMI to measure media multitasking behaviour. In the task-switching block, the stimulus display had a cue, one number, and one letter. The classification task was the same as Ophir et al. (2009). In the dual-task block, the cue was “both”, and participants had to classify both the number and the letter. While the results did not show a relationship between dual-task performance and MMI score, it was found that MMI score was positively correlated with task-switching performance (i.e.,. HMM had shorter response times and lower switch costs). This superior task-switching performance by HMM contrasts with the evidence produced by Ophir et al. (2009). The authors argue that frequent media multitasking does not interfere with attentional control, but instead enhances the ability to reconfigure tasks due to the experiences with alternating between tasks while media multitasking. More benefits of media multitasking have also been demonstrated in other studies.

Expanding on the cognitive research, Minear and colleagues (2013) used measures of attention, working memory, task switching, fluid intelligence, impulsivity and self-control. In addition to the MMI, impulsivity and self-control were measured through self-reported questionnaires. Top and bottom quartiles of the MMI distribution were used as the criterion for HMM and LMM respectively. Fluid intelligence was measured using problems from Raven’s standard progressive matrices (Raven et al., 1998). An automated reading span task was used to measure working memory and the task-switching test was identical to the one used in Ophir et al. (2009). Attention was measured by the Attention Network Task, which identifies three aspects of attention: alerting, orienting, and executive. Results showed that HMM had greater impulsivity, less self-control, and performed worse on measures of fluid intelligence than LMM. However, there were no group differences between HMM and LMM on measures of attention and task-switching. The contrasting findings to Ophir et al. may be due to the populations from which participants were recruited. Those from a very selective university (as in Ophir et al.'s sample) may use very different attentional focus strategies compared to those from a small liberal arts college, as was the case in this study (Minear et al., 2013). Further, the two studies used different criteria for defining HMM and LMM. This could reduce the significance of differences between the two groups if a large number of slightly above or below average users were included in the sample.

Attentional capture in media multitaskers

Participants in Lui and Wong's (2012) study completed the MMI as a measure of media multitasking. A visual search "pip-and-pop" paradigm was used in their experiment to measure attentional capture. Each trial presented a target line (horizontal or vertical line) together with 47 distractor lines of various orientations. Participants had to indicate whether the target was vertical or horizontal. The target and distractor lines changed colour at random intervals, and half the trials had an auditory pip tone accompanying each target colour change. Results showed that HMM performed worse in the visual search task compared to LMM, when there was no tone present. This is consistent with a bottom-up information processing style, contributing to their difficulty in searching for a specific target amongst distractor lines. However, when a tone was present, the difference between groups disappeared. Since the tone corresponds with target colour change, it is supposed to facilitate a pop-out effect of the target and produce better target detection. The large improvement indicates HMM had better multisensory integration and found it easier to utilize a wider scope of stimulus information, such as the unexpected auditory tone, to improve target detection. This may mimic real life scenarios where unexpected environmental stimuli could provide important information, and HMM would be able to capture and integrate this information into the imminent task. Other studies have also examined attentional capture in media multitaskers using different measures.

The same MMI as Ophir et al. (2009) was completed by participants to obtain HMM and LMM groups in a study by Cain and Mitroff (2011) using single distractor task with low working memory demands. Upper and lower quartiles formed the HMM and LMM group respectively, resulting in cut-off scores of higher than 5.36 for HMM and lower than 3.18 for LMM. Each display in the attentional task showed a black background with a single target circle, and there were either 3, 5, 7 or 11 square distractors. On half of the trials, all shapes were green. On the other half, there was a red coloured singleton amongst the green shapes. Each shape contained a symbol (+ or =) that was the same colour as the shape. Participants had to report the symbol inside the target circle. In the first condition, participants were told that the red singleton would never be the target circle. In the second condition, participants were told that the red singleton would sometimes be the target circle, and just as likely to be the target as the other shapes. Results showed that HMM performed worse than LMM on the task, suggesting poorer abilities to filter irrelevant information. While LMM were able to use top-down instructions to enhance performance in the first condition when told that the red singleton would never be in the target circle, HMM showed similar processing of the colour singleton in both conditions. This is consistent with the claim that HMM have a broader attentional scope, allowing them to take in more available environmental information, but sacrificing performance on a specific task. Additionally, attentional and information processing styles in HMM and LMM have also been explored by others, as discussed in the next two studies.

Other studies have used different ranges of MMI scores to determine HMM and LMM groups (Yap & Lim, 2013). Using an experimental task to compare focal attention, MMI scores ranged from .29 to 6.45 with an average of 3.15. HMM were those with above-average MMI scores and LMM were those with below-average MMI scores. The task was to detect a white dot, which could appear at one of four locations. Each trial showed a single or double-box cue, then a target white dot appeared and remained on the screen until a response was made. Participants were told to refrain from responding if the target did not appear. Participants were told that the target would most likely appear in the location of the box cue, and to orient their attention towards it. They were also told that when a double-box cue appeared, the target could be at either location with equal probability. They were instructed to try and divide their attention between both boxes if this occurred. In the single cue condition, all participants showed shorter RTs for targets that appeared in the cued locations than those appearing in irrelevant locations. In the double cue condition, LMM showed comparable RTs for both cued and irrelevant locations. However, HMM had shorter RTs for targets in cued locations compared to those in irrelevant locations. The findings indicate that HMM are more likely to employ a split mode of attention, while LMM employ a unitary mode of attention. While a split mode of attention seems to lead to deficits in performance, the authors also suggest that prolonged media multitasking may serve as a form of practice for this mode, and thus eventually reduce the effort required to maintain split attention (Yap & Lim, 2013).

Differences in media multitaskers on processing of information

Across two experiments, Kazakova et al. (2015) expanded on previous cognitive research by looking at the way people perceptually and conceptually process information while in a media multitasking environment. Perceptual processing refers to the way an individual visually processes information, either by focusing on the whole overall picture (global), or by focusing on the details that make up that picture (local). Conceptual information processing refers to the level at which an individual mentally categorizes information along a concrete (low level) to abstract (high level) continuum. While perceptual processing mainly requires the use of senses, conceptual processing relies on cognitive schemas and representations. In this study, media multitasking behaviour was induced by a simultaneous media exposure condition, compared to a sequential media exposure condition. The researchers through recorded video playback counted switching frequency between the two media. Immediately after the media sessions, participants completed a geometric figure comparison task assessing perceptual processing. Participants were presented with triads of triangles or squares made up of smaller triangles or squares. Participants had to decide which of the two figures at the bottom was more similar to the comparison figure at the top. Higher scores indicated more global perceptual processing while lower scores indicated mainly local perceptual processing. The study found that media multitasking led to using a more local perceptual processing style compared to sequential media use, and the frequency of media switching predicted the level of perceptual processing. In addition, media multitasking led to more concrete interpretations of every day behaviours. This study provides insight on how the context of media consumption can affect the way information is processed. It also suggests that prolonged exposure could alter an individual's information processing style, thus affecting various aspects of executive function and cognitive performance.

Differences in Self-Reported Attention in High and Low Media Multitaskers

The previous section included studies that measured various aspects of cognition using experimental lab-based tasks. This section reviews studies using self-reported measures of attention in HMM and LMM. Only a limited amount of research has been done to investigate media multitasking and attention. Further, existing studies have focused on everyday attention and none have explored attention to emotion specifically. Study 3 will investigate different types of attention (selective, spatial, and temporal) to emotion to expand on the current research on media multitasking and attention (reported in Chapters 6 - 8).

Self-reported levels of media multitasking and self-reported attention problems were found to be significantly associated in two longitudinal survey studies of adolescents

(Baumgartner et al., 2017). Results showed that the relationship between more media multitasking and worse attention was particularly strong for girls, and this may be due to girls being more socially oriented and therefore more easily distracted by social applications such as social media and texting. In addition, the novel study provided preliminary evidence for a long-term effect of media multitasking on attention problems, particularly for adolescents aged between 11-13 years old. This demonstrates that with higher levels of media multitasking, attention problems became worse over time. As there was no evidence to support that attention problems led to increase in media multitasking behaviours over time, it was suggested that attention problems may be a consequence rather than a cause of media multitasking behaviour (Baumgartner et al., 2017).

These results were consistent with Ralph et al. (2013), a study that assessed the relationship between media multitasking, attention and memory failures through a series of self-reported questionnaires, including the MMI, which were administered online. Findings suggest that people who frequently engage in media multitasking have more self-reported experiences of inattention in everyday life. These attentional failures include lapses of attention, attention-related errors, as well as tendencies to spontaneously and deliberately mind-wander. There was no significant relationship between media multitasking and self-reported memory failures, indicating that the attentional failures could be distinguished from general cognitive failures.

Further support was found in another study measuring both participants' self-reported attention and executive function (Magen, 2017) and found that increased media multitasking was significantly correlated with more self-reported deficits of attention and executive function. Magen measured executive functioning including indexes of Behavioural Regulation (Inhibit, Shift, Emotional Control, and Self-Monitor), and Metacognition (Initiate, Working Memory, Plan/Organize, Task-Monitor, and Organization of Materials). Impulsivity and attention was measured using an adult Attention Deficit Hyperactivity Disorder (ADHD) scale. Specifically, media multitasking was related to areas of executive functioning such as self-monitoring, emotional control, and planning. Consistent with previous reports (e.g., Ralph et al., 2013), increased media multitasking was associated with more inattention and impulsivity. These results from Magen's (2017) study suggests that media multitasking is related to a wide range of executive functions. However, there were also inconsistencies with the results compared to previous research such as Ophir et al. (2009). When total media use time was controlled for, media multitasking was no longer significantly related to inhibition and working memory (Magen, 2017). While the differences support cognitive studies showing no relationship between media multitasking and various executive functions (eg., Minear et al., 2013), it could also be explained by an overestimation of one's own abilities during self-report measures (Scharkow, 2016). Other research has combined self-report components together with an experimental measure.

One such study by Brasel and Gips (2011) examined the simultaneous usage of computer and television in younger and older participants (college students and staff, respectively). Participants completed a presurvey on media habits and demographic information. Participants were instructed to spend 30 minutes using the computer and television, and were informed that they would be video-recorded. Participants were allowed to use both devices as they wished to freely surf any website, open any program available on the computer, or change television channels. Two unobtrusive video cameras were used to record their behaviour. After the 30 minutes, participants completed a postsurvey. The recordings revealed that participants switched between media around 120 times in 27.5 minutes. The median gaze time for television was only 1.77 seconds, while the median gaze for computers was 5.3 seconds. In the postsurvey, participants significantly underestimated their own switching behaviour, only estimating 14.8 switches (12.3% of the actual number of switches that occurred). This indicates that people have very little insight on their own media multitasking behaviour.

The existing literature provides mixed results for differences in various aspects of cognitive functioning between HMM and LMM (for review, see van der Shuur et al., 2015). More recently, average media multitaskers have also been compared to HMM and LMM, and findings demonstrate that their performance may not simply fall somewhere in between the two extreme groups (Cardoso-Leite et al., 2016). This calls for additional research to investigate the effect of differing levels of media multitasking behaviour on cognitive processing. Specifically, I have focused on emotional processing during attention tasks in media multitaskers, which has not been studied before. In addition, measuring attention across three dimensions (selective, spatial, and temporal) will be a first. This will be discussed in more detail in later chapters. Emotion processing performance across different attention tasks in media multitaskers is a novel study that will contribute to the cognitive literature, as well as draw some links to existing studies that have examined the psychosocial outcomes of those who media multitask. The next section will review studies that have examined associations between media multitasking and well-being.

Relationship Between Media Multitasking, Social and Mental Well-Being

Study 1 of this research project aimed to explore the links between media multitasking and psychosocial well-being. This includes trait depression, trait anxiety, social anxiety, empathy, general psychological well-being, and personality characteristics. This section covers existing media multitasking studies that have examined associations with well-being related factors.

Previous research has shown that media use (media multitasking not measured) is associated with higher levels of depression and anxiety (e.g., Primack et al., 2009; Selfhout et al., 2009; Weidman et al., 2012), and reduced psychological well-being (e.g., Moody, 2001; Lepp, Barkley & Karpinski, 2014; Srivastava & Tiwari, 2013). Rosen et al. (2013) found that increased media use predicted poorer mental (measured by behaviour problems, attention problems and psychological problems) and physical health among children, preteens and teenagers, even after factoring out eating habits and physical exercise. However, the relationship between media multitasking behaviours and psychosocial outcomes is still a relatively new area of research that is rapidly growing, and will be the main focus of Study 1.

Rosen et al. (2013) researched the link between various individual media usage, attitudes towards technology and preferences for multitasking, technology-related anxiety (i.e., being able to check messages, emails, Facebook etc) and clinical symptoms of psychiatric disorders (three mood disorders and six personality disorders). Facebook use and multitasking preferences emerged as significant predictors for clinical symptoms of major depression and mania. Facebook use was also the top predictor for a number of personality disorders including narcissism, antisocial, compulsive, paranoid, and histrionic. However, having more Facebook friends predicted less dysthymia. Technological anxieties predicted all three mood disorders and most of the personality disorders. Engaging in other types of media use such as talking on the phone showed associations with lower symptoms of major depression while listening to music was related to more signs of mania, antisocial and paranoid disorder. While the study demonstrates some possible benefits to social networking, it seems that those who use it extensively, particularly coupled with multitasking and/or technological anxieties, may be at higher risk for developing symptoms of psychiatric disorders (Rosen et al., 2013). Although these studies did not specifically measure media multitasking behaviours, they indicate that excessive media use is linked to negative mental health and well-being outcomes. It should be noted that there is also a possibility that a large amount of this media use occurred concurrently, particularly if there is a preference for multitasking. In the studies reviewed next, media multitasking was conceptualised and defined in differing ways.

The association between internet use, stress and psychological health in people aged between 14 to 85 years has been investigated (Reinecke et al., 2016). Internet multitasking was defined as using the internet while engaging in other media or non-media activities. Results showed internet multitasking was related to more perceived stress, depression, and anxiety, particularly in the younger age groups (14 to 49 years). They found that communication load (communication demands determined by amount and frequency of sending, receiving and checking emails, messages, and social media) was related to perceived stress, especially for older participants who were above 50 years old. It was suggested that perceived social pressure and fear of missing out were motivators for increasing communication load and engaging in internet multitasking. Younger participants were more vulnerable to feeling this fear than older participants. The study demonstrates that increased communication load and internet multitasking is related to an increased risk of detrimental effects on psychological health and well-being (Reinecke et al., 2016).

One study investigated whether media multitasking was a predictor of depression and anxiety symptoms in a healthy student population (Becker, Alzahabi & Hopwood, 2013). The MMI was administered to measure the amount of concurrent media use. The Patient Health Questionnaire (PHQ; Spitzer, Kroenke & Williams, 1999) and Social Phobia Inventory (SPIN; Connor et al., 2000) were used to measure depressed mood and social anxiety, respectively. Participants also completed the extraversion and neuroticism scales of the Big Five Inventory (BFI; John, Donahue & Kentle, 1991). Results showed that media multitasking was a unique predictor of self-reported symptoms of depression and social anxiety, even after personality traits (extraversion and neuroticism) were controlled. Overall media use was not associated with social anxiety, but levels of media multitasking was.

Additionally, neuroticism was associated with higher levels of depression and social anxiety. The results suggest that personality traits may influence one's dispositional vulnerabilities to mood and anxiety problems whereas media multitasking might be an environmental factor that contributes to increased vulnerabilities to mood and anxiety problems. The authors explain that media multitasking may be associated with decreased top-down attentional control (see Ophir et al., 2009), hence disrupting active coping mechanisms that facilitate the rapid shift of attention away from negative stimuli. Alternatively, depressed or socially anxious people may tend to engage in media multitasking as a means of escaping from the negative emotional state.

Findings were consistent with Becker et al. (2013) in Xu et al. (2016) a study that examined the contribution of media multitasking on social and psychological well-being in university students. In this study, media multitasking included the use of media whilst interacting with others. They distinguished social interaction as either synchronous (real-time interaction such as face-to-face, phone calls and video chatting) or asynchronous (e.g., texting and social networking sites). Results showed synchronous social interaction was related to positive well-being such as social success, normalcy, and self-control. The findings also indicated media multitasking during synchronous, but not asynchronous, social interaction significantly decreased social success. This suggests using media while having real-time interaction likely reduces its positive benefits, and contributes to poorer psychosocial well-being.

Participants of a younger age

Additional evidence indicated that the relationship between media multitasking and well-being extends to younger people as well, a group known to be heavy users of media (Voorveld & van der Goot, 2013). Pea et al. (2012) studied media use, media multitasking behaviour and social well-being in girls aged between 8-12 years old. A mass online survey was conducted, encompassing questions about the use of six media categories and about face-to-face conversations. The survey elicited information about age, access to computers and television, and some general questions about the participant's friends. The survey also elicited information about daily usage of media individually and simultaneously with other media forms, and face-to-face interaction time with and without media use. The third section asked girls to rank their level of agreement on general social outlook statements. The fourth section compared participants' online friends and in-person friends along various dimensions. The last section included other questions including video usage, mobile phone usage and sleep. Overall, video use, online communication and media multitasking were associated with negative socioemotional outcomes. These included feeling less social success, not feeling normal, having more friends whom parents felt were bad influences, and sleeping less. It was found that music, talking on the phone, and online communication were positively correlated with media multitasking. Having a mobile phone and having a television in one's room were also positively correlated with media multitasking. Face-to-face interaction was negatively related to media multitasking, suggesting a trade-off relationship for young girls. Higher levels of face-to-face communication were associated with positive socioemotional outcomes. The study shows that high uses of media that do and do not involve interacting with others are associated with negative social well-being in young girls. However, the direction of causation is still unclear and more research is needed to clarify whether media multitasking causes issues in social well-being, or whether people with reduced social competencies are drawn to spending more time on multiple technologies.

Research with contrasting findings

Not all studies show a relationship between media multitasking and well-being. One study by Shih (2013) developed an instrument (The Survey of the Previous Day; SPD) to quantify media-media multitasking, media-nonmedia multitasking, nonmedia-nonmedia multitasking, and sole-tasking (i.e., engaging in one task only). The relationship of these behaviours and several psychosocial measures were then examined. Results did not show any significant relationship between media multitasking and well-being, emotional positivity, sociability, or impulsivity.

The mixed results in the literature could be due to varying populations and measures used. Studies have found media multitasking is related to various negative psychosocial outcomes (e.g., Becker et al., 2013), and that this relationship occurs in people of different age groups (Peat et al., 2012; Reinecke et al., 2016). Study 1 aimed to contribute to the existing literature on media multitasking and psychosocial well-being by using a range of measures including trait depression, trait anxiety, social anxiety, empathy, well-being, and personality measures. Previous studies have only used state measures of depression and anxiety, and no study has included such a wide range of variables to examine the links between media multitasking and psychosocial outcomes. In addition, empathy in media multitaskers has not yet been explored even though it is known to be an important factor in social well-being (Levesque et al., 2014). Also, if there is a trade-off between amount of media multitasking and face-to-face interaction, it is possible that the development and maintenance of empathy levels could also be affected. The next section will review media multitasking studies that have focused on a range of personality traits.

Personality Traits as Predictors of Media Multitasking Behaviour

Studies have investigated various personality characteristics and media multitasking behaviours. However, most of these studies are unable to ascertain the direction of the relationship (i.e., whether people develop these personality traits due to multitasking, or whether people with these personality traits are more likely to multitask). Jeong and Fishbein

(2007) examined the prevalence of media multitasking in 14 to 16 year olds and predictors of this behaviour. It should be noted that this study defines media multitasking as inclusive of the use of media with another non-media activity (e.g., watching television and eating). Online surveys were conducted, and included measures of multitasking (e.g., how often do you do your homework while listening to audio media?), media ownership (e.g., do you have a television in your bedroom?), sensation seeking (e.g., I would like to explore strange places), and socio-demographic variables. Consistent with previous research (Rideout et al., 2010), youths were found to spend considerable amounts of time media multitasking, with audio-based, television-based and Internet-based multitasking occurring the most. For non-media activities, youths reported being more likely to multitask with media when interacting with friends than while doing homework or eating. This may raise concerns over the quality of social interactions youths are engaging in, and what result this may have on the development of their social competencies. Media ownership, especially access to media in their bedrooms, was associated with more media multitasking. Sensation seeking was found to be positively related to total multitasking, and had the strongest correlation with audio-based multitasking. This study demonstrates that media multitasking in young people is highly prevalent, even during non-media activities such as interacting with others. Personality traits (such as sensation seeking) may be a predispositional factor to media multitasking, and media multitasking may also satisfy the needs of individuals with these personality traits.

Sanbonmatsu et al. (2013) investigated the relationship between personality and multitasking ability. The study used the MMI as a measure of media multitasking frequency, and measured impulsivity and sensation seeking. The Operation Span Task (Unsworth et al., 2005) was used to measure multitasking ability. In this task, participants had to remember a series of 2-5 letters while math problems and possible solutions were presented. Participants indicated whether the solutions were true or false, and recalled the letters in order of presentation. Participants ranked their own perceived multitasking abilities with respect to the general adult population. Results showed that lower scores on objective multitasking ability (Operation Span Task performance) was correlated with higher perceived multitasking ability and higher perceived multitasking ability was correlated with higher multitasking frequency. This suggests that those who have an inflated view of their own multitasking ability tend to multitask more frequently, but they may not be the most capable at it. High sensation seekers, especially those scoring high in disinhibition, were more likely to media multitask than low sensation seekers. Participants who scored higher on impulsivity had higher levels of media multitasking. This suggests that those who multitask heavily are more likely to be those who have difficulty focusing attention or concentrating on a single task. Further research on personality supported these findings. Yang and Zhu (2015) found that media multitasking was related to higher levels of impulsivity and sensation seeking, as well as poorer time management in Chinese adolescents.

A recent exploratory study of media multitasking predictors by Duff et al. (2014) conducted surveys of a student population and national consumer population. Self-reported executive control was measured, including cognitive failures and personal control. Other self-reported measures included sensation seeking, creative mentality, need for simplicity, and imagination. Sensation seeking and higher creativity were predictors of media multitasking behaviours. Need for simplicity and personal control were positively related to media multitasking, but only in the student sample. Gender and age were significant predictors in the national sample only, but this may be due to the narrower age range in the student sample (Duff et al., 2014). Self-reported cognitive failures and imagination were unrelated to media multitasking behaviours, which was inconsistent with other studies (Magen, 2017; Ralph et al., 2016). Overall, it appears that some personality traits (such as sensation seeking and creativity) are predictors of media multitasking behaviours.

The few studies available showing links between media multitasking and personality so far suggests that there could be some consistency of a prevalent relationship between the two, particularly for traits of impulsivity and sensation seeking (Duff et al., 2014; Sanbonmatsu et al., 2013; Yang & Zhu, 2015). More research could be done to explore additional personality characteristics, particularly those that have been associated with well-being. Study 1, which will be discussed in the next two chapters, will seek to expand on previous studies by including personality measures including extraversion, agreeableness, conscientiousness, neuroticism, openness, and narcissism in addition to the MMI.

Summary

Research has examined media multitasking and its relationship between cognition and well-being, and the current literature provides some insight into possible areas of concern. Some studies suggest negative effects on cognitive performance such as task-switching (Ophir et al., 2009), distractor filtering (Cain & Mitroff, 2011), working memory (e.g., Ralph & Smilek, 2017) and self-reported attention (Ralph et al., 2013). Other evidence shows media multitasking may have unfavourable effects on psychosocial outcomes such as well-being (Pea et al., 2012; Xu et al., 2016), overall stress (Reinecke et al., 2016) and increased symptoms of depression and anxiety (Becker & Alzahabi, 2013). However, some studies claim that media multitasking is not harmful to well-being (Shih, 2013), and may even have beneficial effects such as better multisensory integration (Lui & Wong, 2012). Exploratory studies have investigated several personality traits and consistently found sensation seeking to be one of the predictors of media multitasking behaviour (Duff et al., 2014; Jeong & Fishbein, 2007; Sanbonmatsu et al., 2013). Other predictors include impulsivity (Sanbonmatsu et al., 2013), personal control and creative mentality (Duff et al., 2014).

Given that the existing research in this area is limited and inconsistent, the research reported in this thesis aimed to further examine the link between media multitasking and psychosocial outcomes, which will be done in Study 1. Chapters 2 and 3 will cover Study 1, which included measures of trait depression, trait anxiety, social anxiety, empathy, psychological well-being, and personality variables. Chapter 2 will refer to media multitasking as concurrent media use only, while Chapter 3 will draw attention to media use during face-to-face interaction. To date, few studies have examined media multitaskers using visual attention tasks, and no research has been done on emotion processing of media multitaskers using visual attention tasks. Study 3 will explore whether different levels of media multitasking (heavy, average, light) is linked to performance on attention tasks, and whether differences in biases towards specific emotions are present. Investigating this may also provide a connection between one aspect of cognitive functioning, and the psychosocial outcomes that have so far been found. This will be discussed in later chapters.

CHAPTER 2: STUDY 1

ASSOCIATIONS BETWEEN MEDIA MULTITASKING, PERSONALITY CHARACTERISTICS, AND PSYCHOSOCIAL OUTCOMES

Across media multitasking studies, only a small number of psychosocial variables are typically measured, and these have often been different across the studies. For example, studies have investigated state depression and social anxiety (Becker et al., 2013), mood and personality disorders (Rosen et al., 2013), stress (Reinecke et al., 2016) and more generally, social and psychological well-being (Pea et al., 2012; Reinecke et al., 2016; Shih, 2013; Xu et al., 2016). Even where the same constructs are examined, researchers have employed different measures. Some media multitasking studies have also investigated the link between media multitasking and personality traits. While the Five-Factor model theory (Goldberg, 1981; McCrae & Costa, 1987) and existing literature has documented a well-established relationship between personality traits and well-being, it seems that the associations between personality, media multitasking, and psychosocial outcomes have not been explored in the same study. Study 1 investigated these relationships by examining the role of media multitasking behaviours as a potential mediator of the relationship between personality and psychosocial outcomes. Study 1 explored a wider range of psychosocial well-being factors to expand on the current literature and provided a further evaluation of the relationships between media multitasking, psychosocial outcomes, and personality traits. It should also be noted that to date, no other published study has explored the relationship between media multitasking and empathy, which is an important factor in maintaining social relationships and social well-being.

Media Multitasking, Psychosocial Well-being, and Personality Traits

As a more detailed literature review on media multitasking studies was provided in

Chapter 1, only a brief recap will be provided here. The existing research on media multitasking and psychosocial well-being, while limited, has so far indicated a negative relationship between them. Only one study has shown a null relationship between media multitasking and well-being, including emotional positivity and sociability (Shih, 2013). Becker et al. (2013) examined state depression and social anxiety and found that higher levels of media multitasking was related to higher levels of depression and social anxiety. This was supported by Reinecke et al. (2016) who found that higher levels of internet multitasking was related to more self-reported depression and general anxiety in younger and older adults.

Media multitasking studies have also used measures of general social and/or psychological well-being. For example, Reinecke et al. (2016) found that stress level was positively associated with internet multitasking. For social well-being, results from Xu et al. (2016) showed that media multitasking during social interaction was associated with decreased social success. This was supported by another study that investigated young girls' media multitasking behaviour and social well-being (Pea et al., 2012). Girls who engaged in more media multitasking had less social success, fewer feelings of normalcy, and less sleep. They also had less face-to-face social interaction with others, which is well-known to be related to well-being (e.g., Lyubomirsky, King & Diener, 2005). Rosen et al. (2013) investigated clinical symptoms of mood and personality disorders and showed that increased media multitasking was associated with more symptoms of a range of clinical disorders. This also provides insight that media multitasking may be related to general personality traits as well.

The presence of a relationship between media multitasking and personality traits appears to be fairly consistent, but only a few traits have been explored. Sensation seeking and impulsivity have been most widely examined in media multitasking studies as predictors of media multitasking behaviour. Besides Shih (2013) who showed no relationship between media multitasking and impulsivity, results have otherwise been consistent in showing that individuals with more impulsivity and higher sensation seeking personality traits are more likely to media multitask (Duff et al., 2014; Jeong & Fishbein, 2007; Sanbonmatsu et al., 2013; Yang & Zhu; 2015). Duff et al. (2014) also found that creative mentality, need for simplicity and need for personal control were related to media multitasking behaviours. Becker et al. (2013) also found relationships between extraversion and neuroticism, and media multitasking. Participants with higher levels of neuroticism also had higher levels of depression and social anxiety. Another study showed a negative relationship between total internet usage and agreeableness, conscientiousness and extraversion (Landers & Lounsbury, 2006). The current study adds to the existing literature by including measures of the Big-5 personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness) and narcissism, in addition to MMI and measures of well-being such as depression, anxiety, empathy, and general well-being.

Personality Traits and Psychosocial Well-being

Another relationship that has been widely established within the literature is the link between personality traits and psychosocial and subjective well-being (e.g., Clark et al., 1994; Kotov et al., 2007). While research has considered a range of different personality characteristics and well-being outcomes, this section will focus on those that are most relevant to Study 1 such as those that have used the same or very similar variables (i.e., Big 5 and narcissism traits).

The Five-Factor model outlines five main personality factors, otherwise known as the Big 5 (Goldberg, 1981). These five traits are: extraversion, agreeableness, conscientiousness, neuroticism, and openness. Each trait is associated with characteristics in an individual’s way of thinking, feeling, and behaving. Thus, this may have direct or indirect effects on a person’s well-being. Individuals who are high on extraversion draw energy from being around others, and are often assertive, active, outgoing, and seek social interaction. These characteristics are opposite descriptions of anxiety, depression, and indicate that a highly extraverted person would be more likely to seek social support in times of distress, which would indirectly reduce their risk of depression.

Agreeableness refers to how well people get along and interact with others (Goldberg, 1981). Those who are high in agreeableness tend to be well-liked and respected because they are sensitive to the needs of others, humble, altruistic, helpful, and unselfish. Such behaviours and positive relationships with others would likely contribute to a person's feelings of happiness and social involvement, and therefore have a positive influence on well-being.

The conscientiousness trait refers to an individual's tendency to control impulses and behave in ways that are both socially acceptable and goal-directed (Goldberg, 1981). Individuals high on conscientiousness are usually persistent, reliable, hardworking, ambitious, self-disciplined and consistent. These individuals are more likely to succeed in careers and achieve their goals, therefore reducing risk of depression. Generally, people high in conscientiousness are likely to be low on anxiety because things are mostly stable, well-planned, and they feel in control. However, they might show more resistance to changes or acceptance of failure, which may lead to high levels of anxiety when faced with significantly negative life events.

People who score highly on neuroticism are more emotionally unstable, temperamental, self-conscious and critical, insecure, pessimistic, jealous, and uncomfortable with themselves (Goldberg, 1981). These characteristics leaves the person highly vulnerable to being fearful, sadness, worry, and low self-esteem – all of which are risk factors for developing anxiety and/or depression. These characteristics would also likely affect one's relationships with others in a negative way, which would in turn hurt their own well-being.

Lastly, openness is described as the depth and complexity of one's mental life and experiences (Goldberg, 1981). This involves being willing to try new things, be creative, curious, and imaginative. People who score high on openness generally love learning, meeting new people, and engage in a variety of interests especially artistic and creative ones. This would likely be uncharacteristic of social anxiety, and these interests provide a variety of self-care options that would be a protective factor against depression and anxiety.

A meta-analysis by Kotov and colleagues (2010) examined the link between Big 5 personality traits, as well as disinhibition, with depressive, anxiety and substance use disorders in adults. High neuroticism and low conscientiousness were associated with all diagnostic groups. Low extraversion was also related to a number of disorders, particularly, dysthymia and social phobia, while high disinhibition and low agreeableness showed a specific relationship with substance use disorders. Malouff, Thorsteinsson and Schutte (2005) also examined personality-psychopathology associations and concluded that mental illness in general is associated with high neuroticism, low conscientiousness, low agreeableness, and low extraversion, but not associated with openness.

These results were supported by another study investigating the relationship between Big 5, behavioural inhibition, and anxiety disorder symptoms in children (Vreeke & Muris, 2012). Results from this study demonstrated that parents of clinically anxious children rated their child higher on neuroticism and behavioural inhibition, but lower on extraversion, conscientiousness, and openness. Further, ratings on neuroticism and behavioural inhibition were significant predictors of anxiety disorder symptoms (Vreeke & Muris, 2012).

For more general well-being factors, often referred to as subjective well-being, studies have regularly found correlations between Big 5 personality traits and a range of subjective well-being factors, with many studies also finding these personality traits to be predictors of well-being. In particular, extraversion and neuroticism seem to have the most consistent links to well-being, especially life satisfaction and positive and negative affect respectively (see Steel et al., 2008). Hayes and Joseph (2003) measured life satisfaction and happiness, and found that high extraversion, low neuroticism, and high conscientiousness were associated with both well-being measures.

Other studies showed that extraversion, conscientiousness and agreeableness were predictors of positive subjective well-being in college students (Lui et al., 2016) and so was the openness trait in adolescents (Singh & Lal, 2012). Big 5 personality characteristics in children also had relationships with life satisfaction, with neuroticism having the strongest negative association, followed by positive associations for openness, extraversion, and conscientiousness (Goswami, 2014). Similar links between Big 5 personality traits and subjective well-being have been found across states in America (McCann, 2011) as well as cross-culturally (e.g., Galinha et al., 2016; Ha & Kim, 2013; Malkoc, 2011). Galinha et al. (2016) also noted that while low neuroticism was a predictor of subjective well-being in individualistic and well-developed countries such as America and Sweden, satisfaction with relationships was a stronger predictor of subjective well-being in collectivistic and less developed countries such as India.

The relationship between personality and well-being may even be so robust that childhood indicators of personality can predict adaptive psychological and social function in middle adulthood (Blatny et al., 2015). The longitudinal study found that extraversion measured during adolescence was the best predictor of well-being (life-satisfaction, self-esteem, and self-efficacy), while extraversion, childhood disinhibition and negative affectivity predicted career stability (Blatny et al., 2015). Overall, research points to a significant and consistent relationship between the Big 5 personality traits and general well-being. The current study aims to contribute to this existing knowledge by exploring the role of a newer phenomenon, media multitasking, within this relationship.

An additional personality trait that was explored in Study 1 is narcissism. Again, narcissism has been consistently linked to psychopathology and psychosocial outcomes (e.g., Calhoun et al., 2000; Lau et al., 2011; Washburn et al., 2004), however evidence for this association has been more mixed, leading researchers to agree that the concept of narcissism is multidimensional. According to Calhoun et al. (2000), narcissism can present as maladaptive (i.e., exploitative, entitlement, grandiose) and adaptive (leadership, superiority, self-sufficiency), and one way to explore their relationship to different psychopathologies would be to distinguish externalizing (e.g., overt aggression) from internalizing problems (e.g., anxiety and depression). For example, a study of adolescents found that total narcissism was positively related to self-reported delinquency, overt aggression, and relational aggression (Lau et al., 2011). Higher scores on maladaptive narcissism was found to be associated to more delinquency and aggression, however higher scores on adaptive narcissism was related to less anxiety symptoms. Similarly, Calhoun et al. (2000) found that adaptive narcissism was negatively associated with anxiety, depression, and emotional problems, but this was not true for maladaptive narcissism. Washburn et al. (2004) found that in students from a high-crime community, maladaptive (exhibitionism) narcissism was positively associated with depression and anxiety. This is consistent with previous research finding a relation between trait anxiety and narcissism subscales of entitlement and exploitativeness. Nevertheless, adaptive narcissism was not associated with these internalizing problems at all (Washburn et al., 2004).

Other studies have segmented the narcissism construct into grandiose and vulnerable traits (e.g., Dickinson & Pincus, 2003). While narcissistic grandiosity is more typically measured and identified as arrogance, exploitativeness, and self-absorption, narcissistic vulnerability is characterized as underlying shyness, affective dysregulation coupled with a strong need for admiration and idealized expectations for the self and others (Tritt et al., 2009). These vulnerable traits are arguably risk factors for depressive symptoms, given the high risk of narcissistic injury when these needs and ideals are not met (Dickinson & Pincus, 2003; Rathvon & Holmstrom, 1996). Studies like Kealy, Tsai and Ogrodniczuk (2012) and Tritt et al. (2009) support this by showing a relationship between pathological narcissism and depressive and anxious tendencies. Other studies show a strong link between narcissism and depression across different clinical samples and in both self-reported and clinical assessments of depression (Watson et al., 2002). With this existing evidence, the current study will explore the link between media multitasking, personality, and psychosocial outcomes. Since the literature demonstrates a relationship between media multitasking and some personality variables, as well as media multitasking and some psychosocial outcomes, it would be helpful to further connect these constructs and explore additional personality and psychosocial variables to gain more insight on the media multitasking phenomenon.

Hypotheses

In line with previous research, it was hypothesized that those who media multitask more frequently would have poorer psychosocial outcomes. Specifically, higher media multitasking scores are expected to be associated with higher trait depression, higher anxiety (trait and social anxiety), and lower empathy scores. It is also predicted that this relationship would continue to be significant even after controlling for total media use. This direction was inferred through the results of previous studies such as Becker et al. (2013), where media multitasking predicted self-reported symptoms of depression and anxiety. Interestingly, while the three variables (personality, psychosocial outcomes, and media multitasking) appear to have linear relationships with each other, previous studies have not explored further on how these relationships might be related each other. Therefore Study 1 was exploratory in examining the role of media multitasking as a mediator to the established relationship between personality and psychosocial outcomes.

Method

Participants and Procedure

A total of 437 participants (365 females, 72 males) took part in the current study. The mean age was 21.14 years (SD = 5.80, min = 17, max = 50). Participants were first year undergraduates recruited through the Griffith University Research Subject Pool who participated in return for one hour of course credit. All data collected were self-reported by participants. They completed an online survey assessing media multitasking behaviours, and psychosocial outcomes (trait depression, trait anxiety, social anxiety, empathy, and psychological well-being), Big-5 personality, and narcissism.

This study also collected basic demographic information such as age and gender. Participants were asked to provide a method of contact (either a phone number or email address) so that they could be invited to take part in Study 3 if they wished to do so. Participants could also opt not to be contacted for further research. This will be explained in more detail in the overview of Study 3. It should also be noted that data collected as described in Chapter 2 and 3 was done so simultaneously with the same sample, and were therefore two parts of the same study.

Measures

Media Multitasking Index (MMI). The Media Multitasking Index Questionnaire (MMI; Ophir et al., 2009) measures media multitasking behaviours. The current study adapted the original questionnaire to include primary forms of media that were more relevant to current trends in media use. I examined 10 primary forms of media including: reading print, texting/instant messaging, social media sites, non-social media sites, phone/video chatting, television, music, video/online gaming, emailing, and offline computer tasks. Using a matrix (see Figure 2.1), participants rate concurrent media use with each primary media form according to “Most of the time (1),” “Some of the time (0.67),” “A little of the time (0.33),” or “Never (0).” The 10 responses are summed to provide a measure of the amount of concurrent media used while using that primary media form. This sum is then multiplied by the number of hours per week using the primary form of media and divided by the total amount of time using all forms of primary media to give an index for that media. Higher scores indicate more time spent media multitasking. The overall MMI score is the sum of the 10 individual indices. Hence, the MMI is able to show the average amount of media multitasking that is occurring during a typical hour of media usage.

While you are using a social site, how often are you also doing the following at the same time?

	Never (1)	A little of the time (2)	Some of the time (3)	Most of the time (4)
Using print media (e.g., print books, print newspapers etc)	❍	❍	❍	❍
Texting or instant messaging (e.g., SMS, Whatsapp, Facebook messaging, Line etc)	❍	❍	❍	❍
Using another social site (e.g., Facebook, Twitter, Instagram etc - but not games)	❍	❍	❍	❍
Using non-social sites (e.g., online news, blogs, eBooks, general web-browsing)	❍	❍	❍	❍
Talking on the phone or video chatting (e.g., Skype, Facetime, Viber etc)	❍	❍	❍	❍
Listening to music	❍	❍	❍	❍
Watching TV and movies (online and off-line) or YouTube	❍	❍	❍	❍
Playing video games or online games	❍	❍	❍	❍
Emailing	❍	❍	❍	❍
Offline computer tasks (e.g., word processing, programming etc)	❍	❍	❍	❍

Figure 2.1. Example matrix in the MMI questionnaire.

Maryland Trait State Depression Scale – Trait Form (MTSD-T). The MTSD was developed based on the DSM-V criteria for depression (Chiappelli et al., 2014). The MTSD was created to assess depression and distinguish current state symptoms from trait-like symptoms. The MTSD-T contains 18 items. Participants answer items on a 5-point Likert scale. On the trait-form, participants respond based on one's adult life except the past seven days, ranging from 'never' to 'experienced many times in a month for almost every month of my adult life'. Higher scores indicate more depression symptoms. Examples of items from the trait form include:

- It has been hard for me to feel happy most of my life
- It has usually been hard for me to get motivated

The MTSD-State had correlations above .53 with established measures of depression such as the clinician-rated Brief Psychiatric Rating Scale (Overall & Gorham, 1962) and self-reported Profile of Mood States (McNair, Droppleman & Lorr, 1971), while the MTSD-Trait had correlations higher than .48. These correlations were similar to that between the two established measures. The discriminant validity of .52 between the state and trait scales indicated that the MTSD is able to distinguish between the current and enduring load of similar sets of depressive symptoms. Test-retest reliability was good, with intraclass correlation coefficients of .78 for trait depression and .82 for state depression. The MTSD was also chosen for its comparability to the State Trait Anxiety Inventory, which were used in this study. Both measures have a separate state and trait form, and have a similar number of items for each form. The current study only used the trait-forms, while the state-forms was used in Study 3 before participants undertook an experiment.

State Trait Anxiety Inventory – Trait Form (STAI-T). The STAI (Spielberger et al., 1983) is a well-established measure of anxiety, and contains two 20-item forms that distinguish current state symptoms from more enduring trait-like symptoms. For the trait-form that was used in this study, participants responded to statements based on how they generally feel. Participants rated themselves on a 4-point Likert scale ranging from 'almost never' to 'almost always'. Higher scores indicate more symptoms of anxiety. Example items from the trait form include:

- I feel nervous and restless
- I feel like a failure
- I am a steady person (R)

Test-retest reliability on the initial development of this scale ranged from .31 to .86, with intervals ranging from 1 hour to 104 days. These tended to be lower for the state symptoms compared to the trait symptoms, which is unsurprising considering the state symptoms are more transient. Internal consistency was high, ranging from .86 to .95 with various population groups such as high school students and military recruits. Overall correlations between the STAI and other measures of anxiety were higher than .73. Nevertheless, it should be noted that the trait scale in particular was relatively poor in discerning anxious from depressed-state symptoms. This was a similar problem with other measures of anxiety (Spielberger et al., 1983). Similar to the measure of depression, the current study only used the STAI trait-form as the state-form was used in Study 3.

Interaction Anxiousness Scale (IAS). The IAS (Leary, 1983) is a 15-item measure of social anxiety. It considers social interaction across a range of social situations. Only the affective components of social anxiety are included in this measure. Participants rated themselves on statements on a 5-point Likert scale ranging from 'not at all characteristic of me' to 'extremely characteristic of me'. A higher score reflects more social anxiety symptoms. Example items from the IAS are:

- I often feel nervous even in casual get-togethers
- I would be nervous if I was being interviewed for a job
- I seldom feel anxious in social situations (R)

The psychometric properties of the IAS were summarized in Leary and Kowalski

(1993) for data collected over 12 years. The IAS demonstrated high reliability with an 8-week test-retest reliability of .80. Construct validity was shown through strong correlations over .70 with other scales such as social avoidance and distress and shyness (Leary & Kowalski, 1993). The IAS was also significantly correlated with other scales including fear of negative evaluation, embarrassability, social physique anxiety (all *rs* > .43). Although there was a relationship between IAS scores, general anxiety and neuroticism, results showed a much weaker relationship than that between the general anxiety and neuroticism measures (Leary & Kowalski, 1993). This indicates discriminant validity for the IAS as it is measuring social anxiety that is different from general anxiety or neuroticism.

Toronto Empathy Questionnaire (TEQ). The TEQ (Spreng et al., 2009) is a 16-item measure assessing empathy as an emotional process. It was suggested that there is currently no clear definition of what factors the construct of empathy encompasses, and other measures generally have a multifaceted approach including cognitive and emotional aspects of empathy (Spreng et al., 2009). Therefore the purpose of developing the TEQ was to highlight the emotional components of empathy as a separate process to cognitively empathising such as through perspective taking. Participants rate themselves on a 5-point Likert scale ranging from ‘never’ to ‘always’ based on how frequently they felt or acted as described. Higher scores indicate higher levels of empathy. Examples of items from the TEQ are:

- When someone else is feeling excited, I tend to get excited too
- I am not really interested in how other people feel (R)

In Spreng et al. (2009), the TEQ was associated with measures of social decoding, other measures of empathy, and a measure of symptoms of autism. Results showed strong convergent validity. Internal consistency was also good (Cronbach’s $\alpha = .87$). The TEQ also demonstrated good test-retest reliability ($r = .81$).

Well-being Manifestations Measure Scale (WBMMS). The WBMMS is a 25-item questionnaire with six subscales measuring a combination of cognitive and affective components of psychological well-being, and a total well-being score (Masse et al., 1998b). The six subscales are: control of self and events, happiness, social involvement, self-esteem, mental balance, and sociability. Participants rate themselves on a 5-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, and 5 = always) based on their feelings and experiences during the last month. Higher scores indicate higher levels of psychological and total well-being. Examples of items from each subscale are:

- I was able to face difficult situations in a positive way (Control of self and events)
- I found life exciting and I wanted to enjoy every moment of it (Happiness)
- I was curious and interested in all sorts of things (Social involvement)
- I felt that others loved me and appreciated me (Self-esteem)
- I was true to myself, being natural at all times (Mental balance)
- I got along well with everyone around me (Sociability)

For the WBMMS, Masse et al. (1998a) found an overall Cronbach's α of .93 and a range of .71 to .85 for its subscales. Confirmatory factor analysis verifies that the six subscales appear as first-order constructs of well-being and come together as a good indicator of overall subjective well-being (Masse et al., 1998b).

Big 5 Inventory-10 (BFI-10). One of the most well-known psychological models of personality is the Five Factor Model. These "Big Five" factors coined by Goldberg (1990) are: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. The original Big 5 Inventory (John & Srivastava, 1999) is a 44-item self-report questionnaire measuring these five broad domains of personality. Multiple studies have supported its reliability and validity across various cultures, sample group types and age groups (Hee, 2014; Leung et al., 2011; Mount, Barrick & Strauss, 1994). There have been a number of variations made to this measure and also other personality assessments developed based on the Five Factor Model since then. This study used a short form adaptation of the original 44-item inventory for its ease of administration and ability to maintain adequate psychometric properties.

The 10-item scale (BFI-10) was developed by abbreviating the 44-item set and using two items per subscale (RAMMtedt & John, 2007). Each short-phrase item is rated on a 5-point Likert scale from 1 = disagree strongly to 5 = agree strongly. Part-whole correlations are good, with subscales ranging from $r = .74$ to $r = .89$ and an overall $r = .83$ (RAMMtedt & John, 2007). This supports the internal consistency values obtained in the BFI-44 full scale. Test-retest reliability was stable over six to eight weeks in both English and German cultures ($r = .75$). Low mean intercorrelations between subscales ranging from $r = .08$ to $r = .13$ provide evidence of discriminant validity and these values are on par with the overall mean intercorrelation of $r = .21$ obtained from the BFI-44. Although reducing the number of items also lowered external validity, convergent validity remained substantial when compared to the full scale and other measures of personality derived from the Big Five domains. Extraversion, Neuroticism and Conscientiousness had the highest convergent validity correlations. The main focus of the present study is not on personality, but rather, to measure certain personality traits known to be related to one's social interaction patterns. Given that the BFI-10 has the advantage of being a short instrument with acceptable psychometric properties, it will be used here. Higher scores show a stronger indication of that personality trait. Examples of items for each Big-5 personality trait are:

- I see myself as someone who gets nervous easily (Neuroticism)
- I see myself as someone who is outgoing, sociable (Extraversion)
- I see myself as someone who is generally trusting (Agreeableness)
- I see myself as someone who does a thorough job (Conscientiousness)

- I see myself as someone who has an active imagination (Openness)

Narcissistic Personality Inventory-16 (NPI-16). Narcissism is a personality trait defined by patterns of self-focus, grandiosity and self-importance, which often contributes to poor social interactions and relationships, as well as a lack of emotional awareness (Lawson et al., 2008). Narcissism has also been linked to decreased response to emotional faces (White et al., 2012). This study measured narcissism because of its associations with emotional processing and interpersonal skills such as empathy (Watson & Morris, 1991). Ames, Rose and Anderson (2006) created a shorter, unidimensional measure, the NPI-16, which closely parallels the original NPI. It was developed to capture various facets of narcissism including self-ascribed authority, superiority and entitlement, and self-absorption. For the 16 item pairs, participants choose which statement of each pair described them best. Higher scores reflect higher levels of narcissism. An example item pair is:

- I like to be the center of attention (response consistent with narcissism)
- I prefer to blend in with the crowd

Campbell, Rudich and Sedikides (2002) showed that the NPI-16 yielded a Cronbach's α of .72 and consistent with previous research, the NPI-16 also showed correlations with the Big Five constructs and self-esteem, similar to the NPI-40 (Ames, Rose & Anderson, 2006). Test-retest reliability over a 5-week period was also found to be adequate (r = .85). Additionally, convergent, discriminant and predictive validity was also supported by results from the study (Campbell et al., 2002). There is another 15-item version of the NPI (Armor, 2002) that has also shown good internal consistency, overall reliability and predictive validity. However, this measure is more focused on the authority dimension of narcissism. For this study, narcissism was examined as comprised of various facets rather than one particular component. Hence the use of the NPI-16 as a meaningful short measure is preferred over the NPI-15.

Results

The overall mean MMI was 3.21 (*SD* = 0.60). Although Shapiro-Wilk's test of normality was significant ($p = .004$), this test can be biased by large sample sizes (Field, 2009). Skewness and kurtosis were .33 and .12 respectively, which are both in the acceptable range for a normally distributed sample. Q-Q plots of the MMI also indicate that the assumption of linearity has not been violated. An alpha level of .05 was used for all statistical tests. Cronbach's alpha for psychosocial outcome measures were all above .88, which indicates a high level of internal consistency for all measures.

Relationship Between Media Multitasking, Depression, Anxiety, and Empathy

Pearson's correlations were run to investigate the relationship between media multitasking and depression, anxiety (general and social), and empathy (Refer to Table 2.1). Results indicated those who engaged in more media multitasking had higher levels of trait depression and trait anxiety. Level of media multitasking was not correlated with social anxiety. The current study also found that higher overall media multitasking was associated with lower levels of empathy. Nevertheless, it should be noted that these correlations are weak, which is to be expected given that many factors can contribute to these psychosocial outcomes.

Table 2.1. *Correlations between media multitasking, depression, anxiety, and empathy*

	Trait depression	Trait anxiety	Social anxiety	Empathy
MMI	.18**	.12*	.002	-.27**

$*p < .05$, $**p < .01$, $***p < .001$

Relationship Between Media Multitasking and General Well-being (WBMMS)

This study used the WBMMS as a measure of general well-being. Findings indicated that overall media multitasking was negatively associated with sociability, but not significantly associated with any other subscale or overall general well-being. Refer to Table 2.2 for the correlations between media multitasking and the WBMMS and its subscales.

Table 2.2. *Correlations between media multitasking and WBMMS*

Media type	Overall well-being	Control of Self and Events	Happiness	Social Involvement	Self-Esteem	Mental Balance	Sociability
MMI	-.08	-.08	-.05	-.03	-.06	-.09	-.14**

**p* < .05, ***p* < .01, ****p* < .001

Media multitasking is Associated with Personality Traits

The Big-5 and narcissism personality traits were also measured in this study. Higher MMI scores were related to lower agreeableness, conscientiousness and openness scores, and higher narcissism scores (see Table 2.3).

Table 2.3. *Correlations between media multitasking and personality traits*

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Narcissism
MMI	.06	-.13**	-.20**	.04	-.15**	.12*

**p* < .05, ***p* < .01, ****p* < .001

Contribution of MMI to Psychosocial Outcomes After Controlling for Total Media Use and Big 5 Personality Traits

Hierarchical regression analyses were conducted to further investigate the relationship between MMI, trait depression, trait anxiety, and empathy. Separate analyses were run for each dependent variable (trait depression, trait anxiety, and empathy). First, I replicated the regression analyses conducted by Becker et al. (2013). In these analyses, predictors were entered into the regression analysis in two steps. Step one consisted of total hours of media use (*M* = 104.61, *SD* = 3.66), extraversion, and neuroticism. Then MMI score was entered at step two. Refer to Table 2.4, 2.5, and 2.6 for the regression models.

Results showed that even after controlling for total media use, extraversion, and neuroticism, media multitasking significantly contributed to higher trait depression scores, $F(4, 432) = 37.43$, $p < .001$, higher trait anxiety scores, $F(4, 432) = 90.82$, $p < .001$, and lower empathy scores $F(4, 432) = 13.52$, $p < .001$. MMI accounted for an additional 3% of the variance in trait depression. MMI accounted for an additional 1% of variance in trait anxiety and an additional 9% of the variance in empathy.

Table 2.4. *Regression model for trait depression*

	R	R^2	R^2 Change	β
Step 1 (Total media use)	.48	.23***		-.04
Step 1 (Extraversion)				-.08
Step 1 (Neuroticism)				.44***
Step 2 (MMI)	.51	.26***	.03***	.18***

**p* < .05, ***p* < .01, ****p* <.001

Table 2.5. *Regression model for trait anxiety.*

	R	R^2	R^2 Change	β
Step 1 (Total media use)	.67	.45***		.001
Step 1 (Extraversion)				-.17***
Step 1 (Neuroticism)				.58***
Step 2 (MMI)	.68	.46**	.01**	.10**

**p* < .05, ***p* < .01, ****p* < .001

Table 2.6. *Regression model for empathy.*

	R	R^2	R^2 Change	β
Step 1 (Total media use)	.15	.02*		.10*
Step 1 (Extraversion)				.17**
Step 1 (Neuroticism)				.10*
Step 2 (MMI)	.33	.11***	.09***	-.31***

*$p < .05$, **$p < .01$, ***$p < .001$

Although both extraversion and neuroticism were not significantly related to media multitasking, the other Big 5 personality traits were added into the analyses for further investigation. This expands on the work of Becker et al. (2013) and determines whether overall media multitasking adds a unique contribution after controlling for total media use and all Big 5 personality traits. The first step consisted of total hours of media use and the Big 5 personality traits. The next step entered the MMI score. See Tables 2.7, 2.8 and 2.9 for regression analyses for trait depression, trait anxiety, and empathy, respectively.

Results showed that after controlling for total media use and the Big 5 personality traits, media multitasking significantly contributed to higher trait depression scores, $F(7, 429) = 26.47$, $p < .001$, and lower empathy scores $F(7, 429) = 19.66$, $p < .001$. The contribution of media multitasking to higher trait anxiety scores approached significance, but the overall model was significant, $F(7, 429) = 57.65$, $p < .001$. MMI accounted for an additional 2% of the variance in trait depression. MMI accounted for an additional 0.4% of variance in trait anxiety (which was not significant) and an additional 4% of the variance in empathy.

Table 2.7. *Regression model for trait depression (Total media use and Big 5 controlled)*

	R	R^2	R^2 Change	β
Step 1 (Total media use)	.54	.28***		-.04
Step 1 (Extraversion)				-.05
Step 1 (Agreeableness)				-.09*
Step 1 (Conscientiousness)				-.18***
Step 1 (Neuroticism)				.39***
Step 1 (Openness)				.04
Step 2 (MMI)	.55	.30	.02**	.14**

**p* < .05, ***p* < .01, ****p* < .001

Table 2.8. *Regression model for trait anxiety (Total media use and Big 5 controlled).*

	R	R^2	R^2 Change	β
Step 1 (Total media use)	.69	.48***		-.01
Step 1 (Extraversion)				-.15***
Step 1 (Agreeableness)				-.07*
Step 1 (Conscientiousness)				-.15***
Step 1 (Neuroticism)				.54***
Step 1 (Openness)				.02
Step 2 (MMI)	.70	.49	.004	.07

**p* < .05, ***p* < .01, ****p* < .001

Table 2.9. *Regression model for empathy (Total media use and Big 5 controlled).*

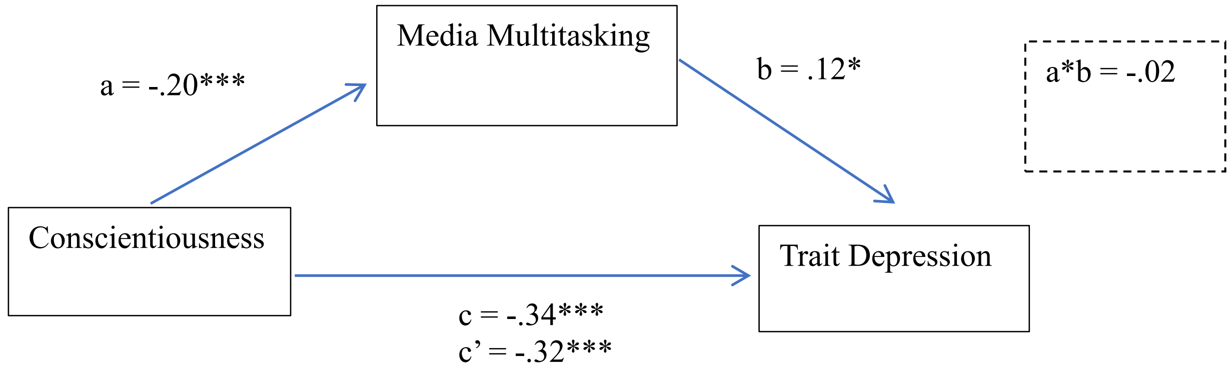
	R	R^2	R^2 Change	β
Step 1 (Total media use)	.45	.20***		.09*
Step 1 (Extraversion)				.13**
Step 1 (Agreeableness)				.29***
Step 1 (Conscientiousness)				.18***
Step 1 (Neuroticism)				.19***
Step 1 (Openness)				.09*
Step 2 (MMI)	.49	.24***	.04***	.19***

**p* < .05, ***p* < .01, ****p* < .001

The Role of Media Multitasking as a Mediator Between Personality Traits and Trait Depression

Regression analyses were used to investigate the hypothesis that media multitasking mediates the effect of personality on depression. A bias-corrected bootstrapping technique using 5000 bootstrapped samples was conducted using Process for SPSS (Hayes, 2013). Hayes (2013) recommends the bootstrapping technique as it does not suffer from the limitations of lack of power (as the Sobel test does), and also does not rely on a normal sampling distribution. To test for mediation, it was first established that each IV (personality trait) was associated with the mediator (media multitasking). Personality traits that were not associated with media multitasking were excluded from further analyses. As outlined in Table 2.3, agreeableness, conscientiousness, openness, and narcissism were significantly related to media multitasking behaviour, but extraversion and neuroticism were not hence these will be excluded from the analyses. A separate mediation model was tested for each personality trait. In addition, the DV social anxiety was excluded from further mediation analyses because it was not associated with the mediator (media multitasking). This section will outline the mediation analyses results for trait depression as the DV.

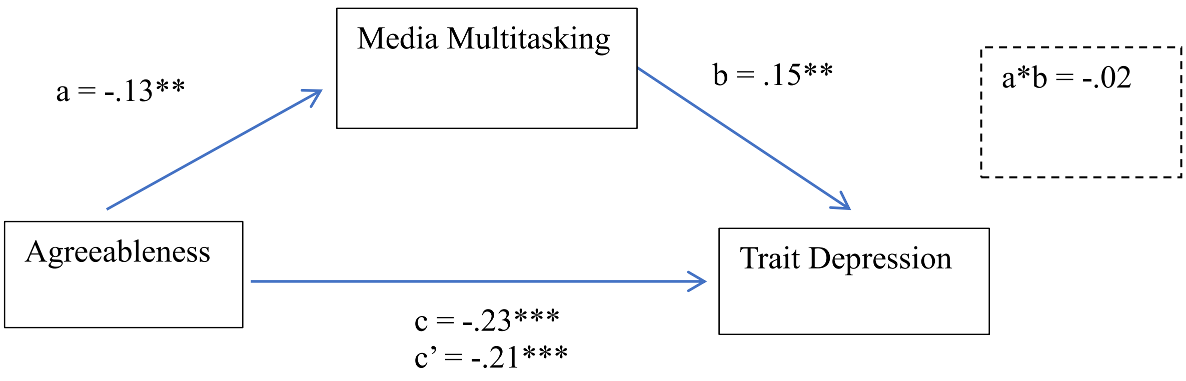
Regression analyses were conducted entering conscientiousness at Step 1 and media multitasking at Step 2. Conscientiousness was associated with trait depression, $\beta = -.34$, $p < .001$, conscientiousness was associated with media multitasking, $\beta = -.20$, $p < .001$, and media multitasking was associated with trait depression after controlling for conscientiousness, $\beta = .12$, $p = .01$. Results showed that conscientiousness accounted for 11.5% of the variance in trait depression, $F(1, 435) = 56.48$, $p < .001$, and media multitasking contributed an additional 1.3% of the variance to the model, $F(2,434) = 31.90$, $p < .001$. The indirect effect was tested using a bootstrap approach and results showed that the indirect coefficient was significant, $\beta = -.02$, 95% CI = -.40, -.05. Since the 95% CI for path a*b does not contain a zero value, this indicates a significant association between the mediating pathway (a*b) and the DV (Preacher & Hayes, 2004). Overall, results suggest that media multitasking partially mediates the relationship between conscientiousness and trait depression (see Figure 2.2).



*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.2. *Mediator model showing the role of media multitasking on the relationship between conscientiousness and trait depression*

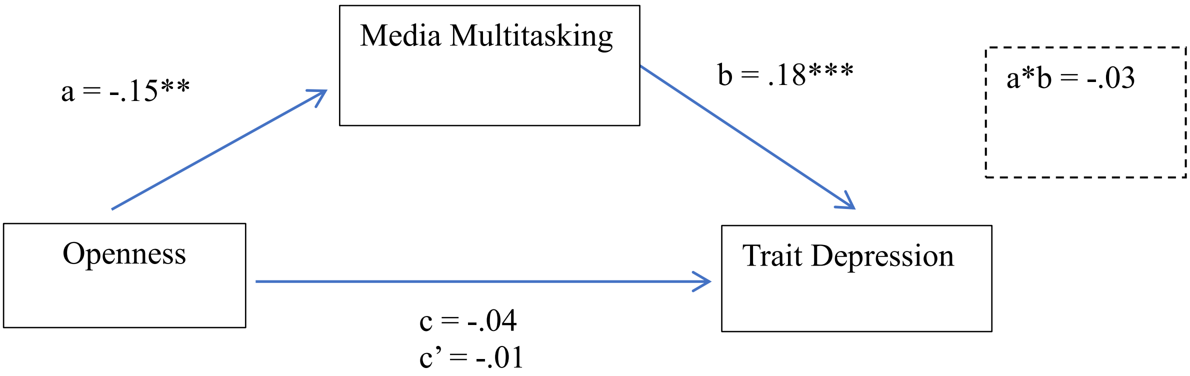
Agreeableness was associated with trait depression, β = -.23, $p < .001$, agreeableness was associated with media multitasking, β = -.13, p =.001, and media multitasking was associated with trait depression even after controlling for agreeableness, β = .15, p = .01. Results showed that agreeableness accounted for 5.3% of the variance in trait depression, $F(1, 435) = 24.27$, $p < .001$, and media multitasking contributed an additional 2.3% of the variance to the model, $F(2,434) = 17.81$, $p < .001$. Results showed that the indirect coefficient was significant, β = -.02, 95% CI = -.43, -.04. Therefore, results suggest that media multitasking partially mediates the relationship between agreeableness and trait depression (see Figure 2.3).



**p* < .05, ***p* < .01, ****p* < .001

Figure 2.3. Mediator model showing the role of media multitasking on the relationship between agreeableness and trait depression

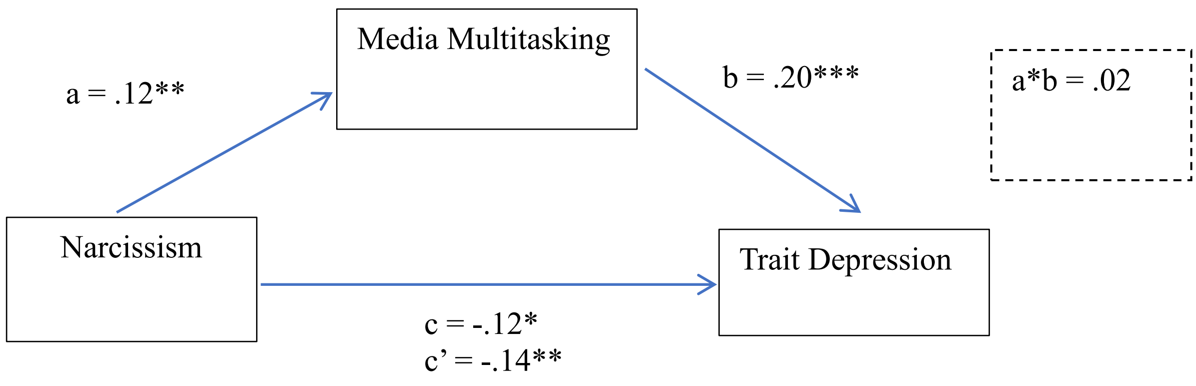
Openness was not associated with trait depression, β = -.04, p = .45. According to Preacher and Hayes (2004), a theoretically predicted mediating effect can still occur even when the bivariate correlation between the IV and DV is not statistically significant. In addition, other studies have found significant relationships between openness and well-being (Goswami, 2014; Singh & Lal, 2012). Therefore mediation was still examined. Openness was associated with media multitasking, β = -.15, p = .001, and media multitasking was associated with trait depression even after controlling for openness, β = .18, $p < .001$. Results showed that openness accounted for 0.1% of the variance in trait depression, $F(1, 435)$ =.56, p =.45, and media multitasking contributed an additional 3.1% of the variance to the model, $F(2,434)$ = 7.34, p = .001. Results showed that the indirect coefficient was significant, β = -.03, 95% CI = -.52, -.08, indicating that media multitasking partially mediates the relationship between openness and trait depression (see Figure 2.4).



$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Figure 2.4. Mediator model showing the role of media multitasking on the relationship between openness and trait depression

Narcissism was associated with trait depression, β = -.12, p = .01, narcissism was associated with media multitasking, β = .12, p = .01, and media multitasking was associated with trait depression even after controlling for narcissism, β = .20, $p < .001$. Results showed that narcissism accounted for 1.4% of the variance in trait depression, $F(1, 435) = 6.12$, p = .01, and media multitasking contributed an additional 3.8% of the variance to the model, $F(2,434) = 11.96$, $p < .001$. Results showed that the indirect coefficient was significant, β = .02, 95% CI = .03, .26. This means that media multitasking partially mediates the relationship between narcissism and trait depression (see Figure 2.5).



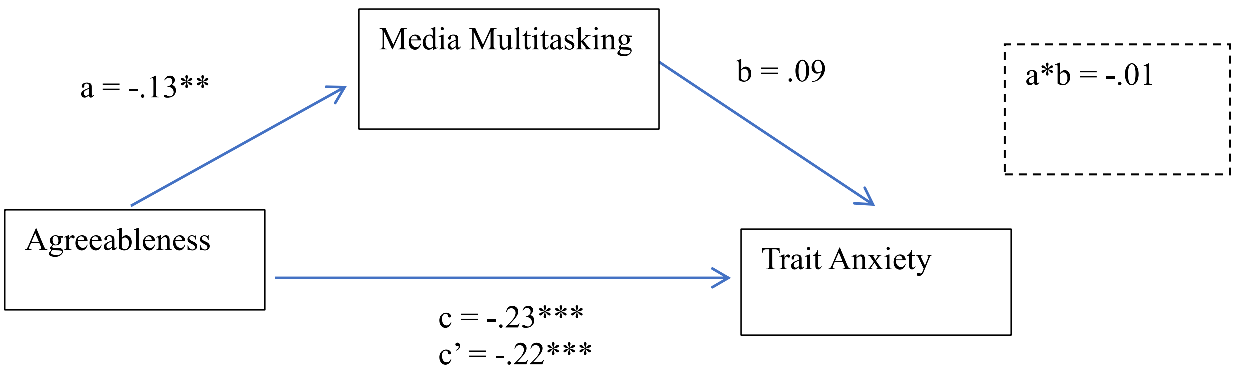
*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.5. *Mediator model showing the role of media multitasking on the relationship between narcissism and trait depression*

The Role of Media Multitasking as a Mediator Between Personality and Trait Anxiety

This section covers results of the mediation analyses with trait anxiety as the DV. Regression analyses were conducted entering conscientiousness at Step 1 and media multitasking at Step 2. Conscientiousness was associated with trait anxiety, β = -.35, $p < .001$, and conscientiousness was associated with media multitasking, β = -.20, $p < .001$. However, media multitasking was not associated with trait anxiety after controlling for conscientiousness, β = .05, $p = .30$. This means that the condition of a significant path b was not met, therefore no mediation effect was present. Therefore, even though media multitasking and conscientiousness were both related to trait anxiety on their own, media multitasking was no longer significantly related to trait anxiety when conscientiousness was controlled.

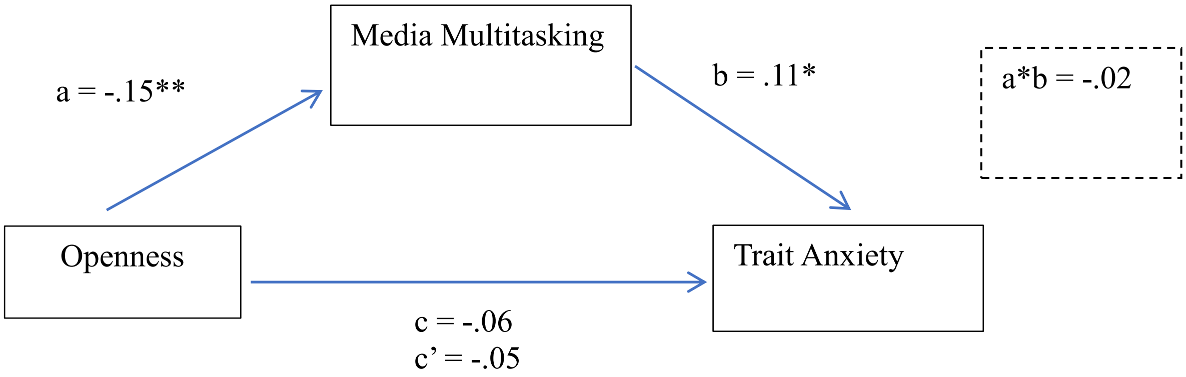
Agreeableness was associated with trait anxiety, β = -.23, $p < .001$, agreeableness was associated with media multitasking, β = -.13, $p = .001$. The relationship between media multitasking and trait anxiety after controlling for agreeableness approached significance, β = .09, $p = .07$. Results showed that agreeableness accounted for 5.4% of the variance in trait anxiety, $F(1, 435) = 24.80$, $p < .001$, and media multitasking contributed an additional 0.7% of the variance to the overall model, $F(2,434) = 14.19$, $p < .001$. While the condition for path b was not met, it approached significance therefore the mediating effect was still investigated to avoid a potential Type II error. The indirect effect was tested using a bootstrap approach and results showed that the indirect coefficient was significant, β = -.01, 95% CI = -.21, -.01. Hence, results suggest that media multitasking partially mediates the relationship between agreeableness and trait anxiety, but the mediating effect was very small (see Figure 2.6).



*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.6. Mediator model showing the role of media multitasking on the relationship between agreeableness and trait anxiety

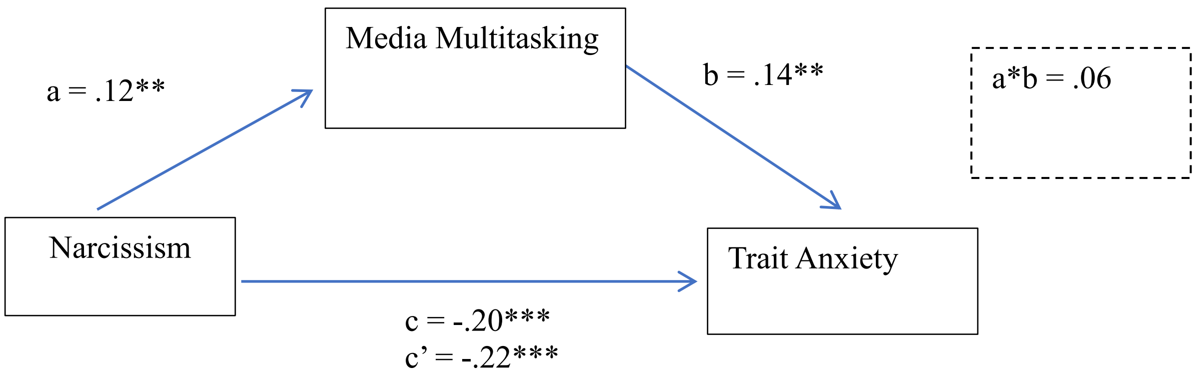
Openness was not associated with trait anxiety, β = -.06, $p = .19$. According to Preacher and Hayes (2004), a theoretically predicted mediating effect can still occur even when the bivariate correlation between the IV and DV is not statistically significant. In this case, mediation was still investigated. Openness was associated with media multitasking, β = -.15, $p = .001$, and media multitasking was associated with trait anxiety even after controlling for openness, β = .11, $p = .02$. Results showed that openness accounted for 0.4% of the variance in trait anxiety, $F(1, 435) = 1.70$, $p = .19$, and media multitasking contributed an additional 1.2% of the variance to the model, $F(2,434) = 3.42$, $p = .03$. Results showed that the indirect coefficient was significant, β = -.02, 95% CI = -.27, -.02 (see Figure 2.7).



*p < .05, **p < .01, ***p < .001

Figure 2.7. Mediator model showing the role of media multitasking on the relationship between openness and trait anxiety

Narcissism was associated with trait anxiety, β = -.20, $p < .001$, narcissism was associated with media multitasking, β = .12, $p = .01$, and media multitasking was associated with trait anxiety after controlling for narcissism, β = .14, $p = .003$. Narcissism accounted for 4% of the variance in trait anxiety, $F(1, 435) = 18.30$, $p < .001$, and media multitasking contributed an additional 2% of the variance to the model, $F(2,434) = 13.84$, $p < .001$. Results demonstrated that the indirect coefficient was significant, β = .06, 95% CI = .01, .14. Therefore, results demonstrate that media multitasking partially mediates the relationship between narcissism and trait anxiety (see Figure 2.8).

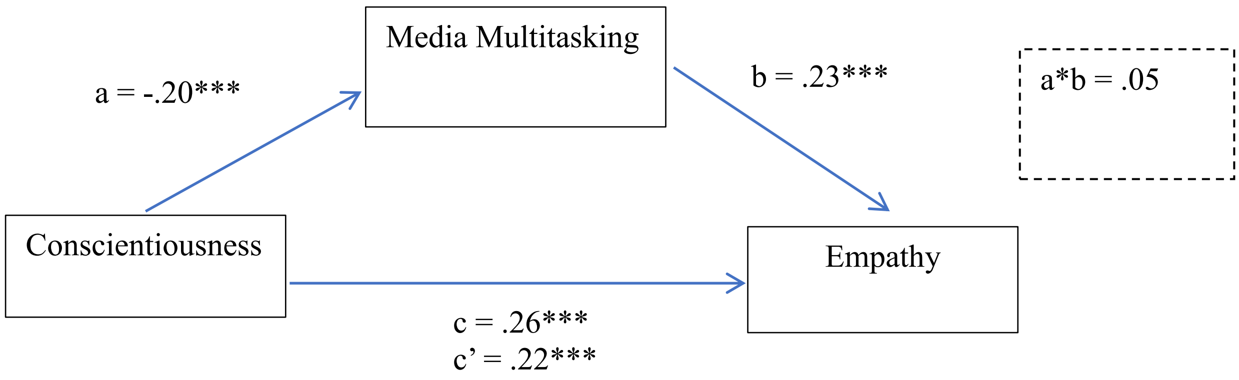


*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.8. Mediator model showing the role of media multitasking on the relationship between narcissism and trait anxiety

The Role of Media Multitasking as a Mediator Between Personality and Empathy

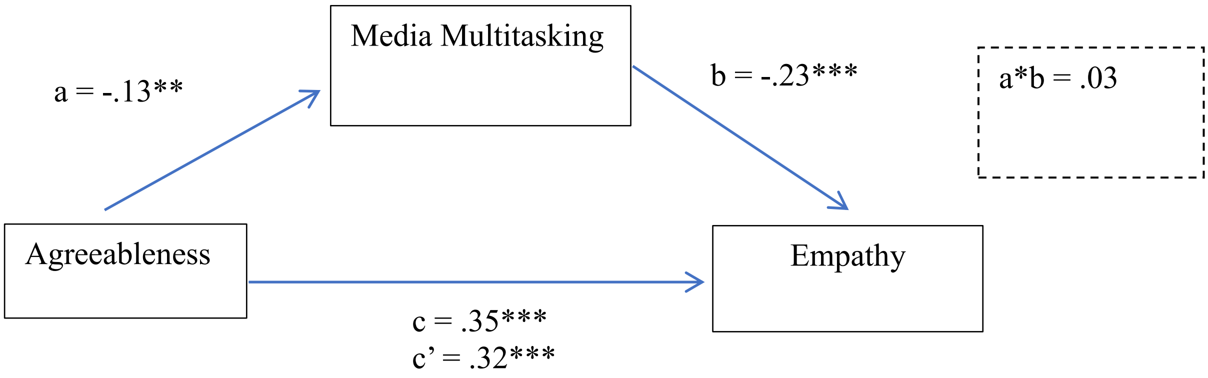
This section outlines findings from the mediation analyses with empathy as the DV. Conscientiousness, agreeableness, openness, and narcissism personality variables will be presented in separate analyses. Regression analyses were conducted entering conscientiousness at Step 1 and media multitasking at Step 2. Conscientiousness was associated with empathy, $\beta = .26$, $p < .001$, conscientiousness was associated with media multitasking, $\beta = -.20$, $p < .001$, and media multitasking was associated with empathy even after controlling for conscientiousness, $\beta = .23$, $p < .001$. Results showed that conscientiousness accounted for 6.9% of the variance in empathy, $F(1, 435) = 32.18$, $p < .001$, and media multitasking contributed an additional 4.9% of the variance to the model, $F(2,434) = 28.95$, $p < .001$. Results indicated that the indirect coefficient was significant, $\beta = .05$, 95% CI = .11, .38. Overall, results suggest that media multitasking partially mediates the relationship between conscientiousness and empathy (see Figure 2.9).



*p < .05, **p < .01, ***p < .001

Figure 2.9. Mediator model showing the role of media multitasking on the relationship between conscientiousness and empathy

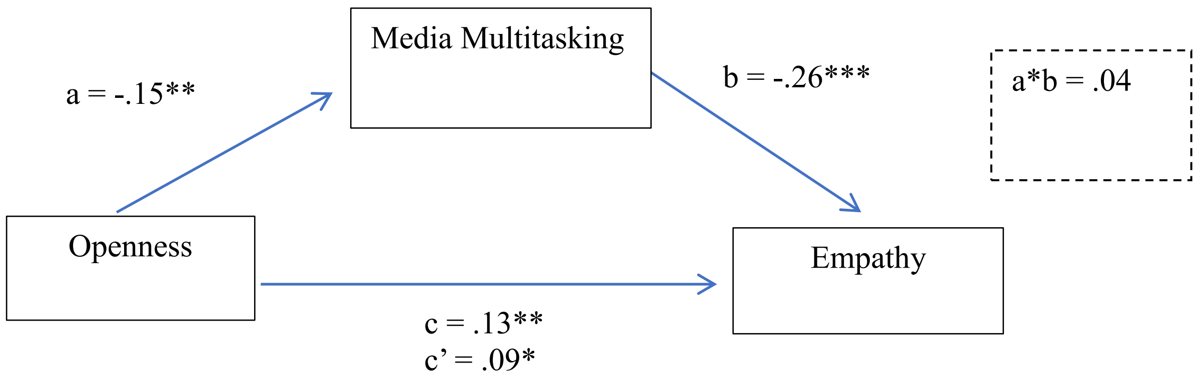
Agreeableness was associated with empathy, β = .35, *p* <.001, agreeableness was associated with media multitasking, β = -.13, *p* =.001, and media multitasking was associated with empathy even after controlling for agreeableness, β = -.23, *p* < .001. Results showed that agreeableness accounted for 12.1% of the variance in empathy, *F*(1, 435) = 59.84, *p* <.001, and media multitasking contributed an additional 5.1% of the variance to the model, *F*(2,434) = 44.97, *p*<.001. Results showed that the indirect coefficient was significant, β = .03, 95% CI = .05, .31. Therefore, results suggest that media multitasking partially mediates the relationship between agreeableness and empathy (see Figure 2.10).



*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.10. Mediator model showing the role of media multitasking on the relationship between agreeableness and empathy

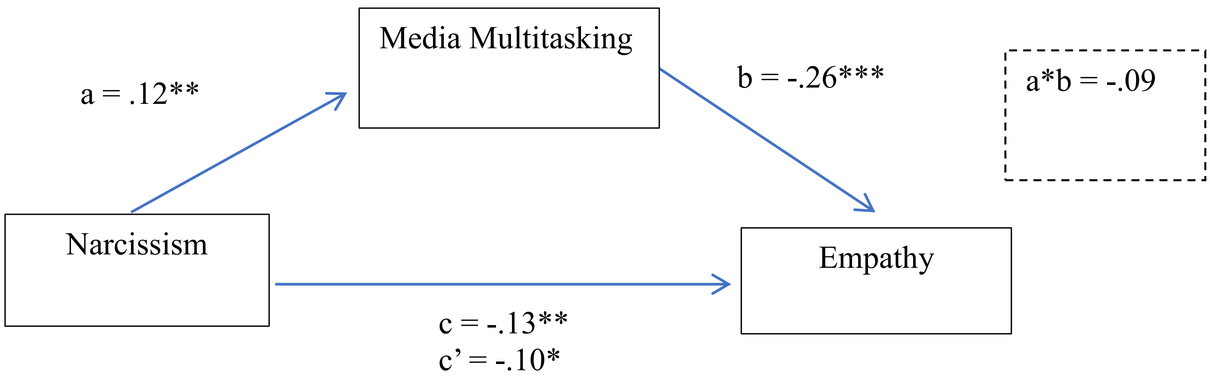
Openness was associated with empathy, β = .13, p = .003, openness was associated with media multitasking, β = -.15, p =.001, and media multitasking was associated with empathy even after controlling for openness, β = -.26, p <.001. Results showed that openness accounted for 1.7% of the variance in empathy, $F(1, 435) = 7.41$, p = .01, and media multitasking contributed an additional 6.4% of the variance to the model, $F(2,434) = 19.02$, p <.001. The indirect coefficient was significant, β = .04, 95% CI = .07, .43, indicating that media multitasking partially mediates the relationship between openness and empathy (see Figure 2.11).



**p* < .05, ***p* < .01, ****p* < .001

Figure 2.11. Mediator model showing the role of media multitasking on the relationship between openness and empathy

Narcissism was associated with empathy, β = -.13, p = .01, narcissism was associated with media multitasking, β = .12, p =.01, and media multitasking was associated with empathy even after controlling for narcissism, β = -.26, p <.001. Results showed that narcissism accounted for 1.8% of the variance in empathy, $F(1, 435) = 7.93$, p =.01, and media multitasking contributed an additional 6.5% of the variance to the model, $F(2,434)$ = 19.66, p <.001. Results indicated that the indirect coefficient was significant, β = -.09, 95% CI = -.19, -.01. This means that media multitasking partially mediates the relationship between narcissism and trait empathy (see Figure 2.12).



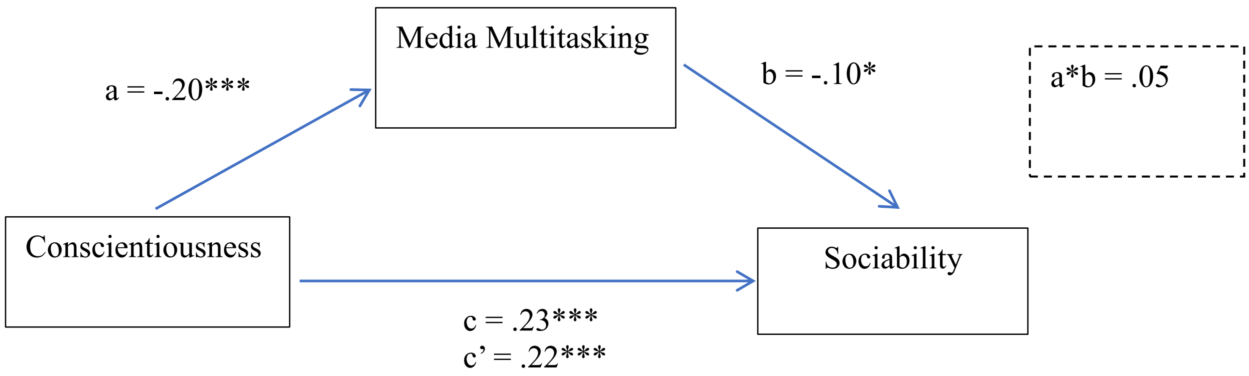
*$p < .05$, **$p < .01$, ***$p < .001$

Figure 2.12. Mediator model showing the role of media multitasking on the relationship between narcissism and empathy

The Role of Media Multitasking as a Mediator Between Personality and Sociability

As MMI was not associated with the WBMMS’s measure of total well-being or its subscales besides sociability, this section outlines findings from the mediation analyses with sociability (as measured by the WBMMS) as the DV. Regression analyses were conducted entering conscientiousness at Step 1 and media multitasking at Step 2. Conscientiousness was associated with sociability, $\beta = .23$, $p <.001$, conscientiousness was associated with media multitasking, $\beta = -.20$, $p <.001$, and media multitasking was associated with sociability even after controlling for conscientiousness, $\beta = -.10$, $p = .04$. Results showed that conscientiousness accounted for 6.1% of the variance in sociability, $F(1, 435) = 28.39$, $p <.001$, and media multitasking contributed an additional 0.9% of the variance to the model, $F(2,434) = 16.44$, $p < .001$. The indirect effect was tested using a bootstrap approach and results showed that the indirect coefficient was significant, $\beta = .02$, 95% CI = .003, .07.

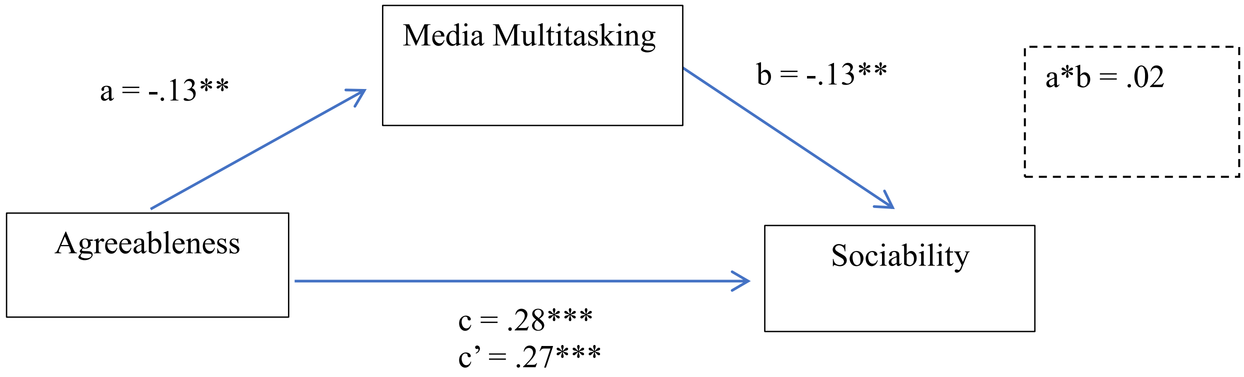
Overall, results suggest that media multitasking partially mediates the relationship between conscientiousness and sociability (see Figure 2.13).



**p* < .05, ***p* < .01, ****p* < .001

Figure 2.13. Mediator model showing the role of media multitasking on the relationship between conscientiousness and sociability.

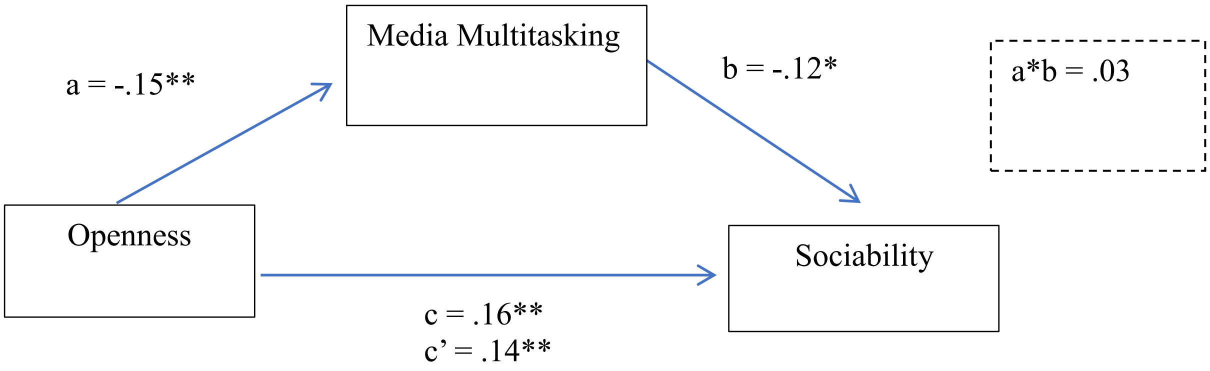
Agreeableness was associated with sociability, β = .28, p <.001, agreeableness was associated with media multitasking, β = -.13, p = .003, and media multitasking was associated with sociability even after controlling for agreeableness, β = -.13, p = .02. Results showed that agreeableness accounted for 7.8% of the variance in sociability, $F(1, 435) = 36.82$, p <.001, and media multitasking contributed an additional 1.2% of the variance to the model, $F(2,434) = 21.35$, $p < .001$. Results showed that the indirect coefficient was significant, β = .02, 95% CI = .004, .06. This indicates that media multitasking partially mediates the relationship between agreeableness and sociability (see Figure 2.14).



*p < .05, **p < .01, ***p < .001

Figure 2.14. Mediator model showing the role of media multitasking on the relationship between agreeableness and sociability.

Openness was associated with sociability, β = .16, *p* <.001, openness was associated with media multitasking, β = -.15, *p* = .001, and media multitasking was associated with sociability even after controlling for openness, β = -.12, *p* = .01. Results showed that openness accounted for 3.9% of the variance in sociability, *F*(1, 435) = 10.99, *p* = .001, and media multitasking contributed an additional 1.5% of the variance to the model, *F*(2,434) = 8.89, *p* < .001. The indirect coefficient was significant, β = .03, 95% CI = .01, .08. The results show that media multitasking partially mediates the relationship between openness and sociability (see Figure 2.15).



**p* < .05, ***p* < .01, ****p* < .001

Figure 2.15. Mediator model showing the role of media multitasking on the relationship between openness and sociability.

Summary of Results

The current findings showed that higher levels of media multitasking was associated with higher levels of trait depression, trait anxiety, and lower levels of empathy and sociability. Higher levels of media multitasking was also related to lower scores on the agreeableness, conscientiousness, openness and higher scores on narcissism personality traits. After controlling for total media use and personality, media multitasking levels still predicted trait depression and empathy, and approached significance for trait anxiety. Media multitasking was also found to partially mediate the relationship between various personality traits (conscientiousness, agreeableness, openness, narcissism) and psychosocial outcomes (trait depression, trait anxiety, empathy, sociability).

Discussion

The aim of this study was to investigate links between media multitasking, psychosocial outcomes, and personality traits. Given the relationships between personality and well-being have been robust in the literature, and the media multitasking literature indicates relationships between media multitasking, personality, and well-being, I therefore chose to explore the role of media multitasking as a mediator between personality and well-being. This direction was in part also chosen because personality is a more enduring trait than well-being, and also predicts well-being (e.g., Goldberg, 1981), personality was examined as the independent variable and well-being to be the dependent variable.

The first hypothesis was partially supported in that those with higher levels of media multitasking behaviours had significantly poorer psychosocial outcomes, but not on all the measures that was expected. Findings showed that higher amounts of media multitasking were significantly related to more trait depression and trait anxiety. This is in line with Becker et al. (2013) who also found media multitasking to be associated with self-reported depression symptoms. More media multitasking was also related to lower levels of empathy, which has not been found in the literature before. In contrast to Becker et al. (2013), results did not show a significant relationship between media multitasking and social anxiety. Even after controlling for total media use and Big 5 personality traits, media multitasking was still significantly associated with higher trait depression, lower empathy, and a trend towards significance for trait anxiety. This adds to the existing knowledge of potential implications (such as poorer well-being) of media use, specifically, media multitasking behaviours.

For general well-being, this study used the WBMMS as a measure. The results showed that media multitasking behaviour was negatively related to sociability but not the other subscales or overall well-being. While this particular finding is consistent with previous research that found media multitasking to be negatively related to a range of general well-being factors such as stress (Reinecke et al., 2016), social success and feelings of normalcy (Pea et al,. 2012; Xu et al., 2016), it also contrasts with previous research as total well-being and other subscales such as happiness, mental balance, self-esteem, and control were not found to be related to media multitasking at all. However, these non-significant findings are consistent with the null relationships between media multitasking and well-being found by Shih (2013). It should be noted that across all studies, different definitions and measures of general well-being have been used, which could account for some of the inconsistencies seen.

One explanation for some of the inconsistencies found across media multitasking studies is that only an overall media multitasking score is typically used without consideration of the types of media activities that contribute to those hours. Therefore, even when the media type is of a social nature (e.g., social sites, phone/video chatting), using it with another media type may discount the benefits of these social interactions. These media multitasking behaviours may also affect the quality of these interactions due to distractibility (e.g., slower response times, less attentive responses). For example, a recent study found that technological interruptions and distractions affected people's relationship satisfaction and was related to more relationship conflict (McDaniel & Coyne, 2016). Prolonged media multitasking behaviour then leads to reduced opportunity for the development of empathic skills even when the media activity has positive social interactions on its own. On the other hand, it could be that media multitasking while doing work-related tasks such as emailing may be related to feelings of competence or connectedness with others because the original task may be perceived to be mundane on its own. In addition, activities such as playing video games could become less isolating and be related to higher sociability when playing with others through online gaming platforms, which often include social interaction through voice chat, for example. However, these social interactions may not always be friendly or positive, which may then result in lower happiness and mental balance, especially if these cyberbullying encounters happen repeatedly.

The results from this study provide support to existing research that media multitasking is associated with personality traits (Duff et al., 2014; Jeong & Fishbein, 2007; Sanbonmatsu et al., 2013; Yang & Zhu, 2015), although different personality traits were measured across these studies and the current one. In this study, I aimed to contribute to the literature by exploring different personality variables (Big 5 and narcissism), as well as clarify the link between media multitasking, personality, and psychosocial outcomes. Overall findings showed that media multitasking is related to personality traits of less agreeableness, conscientiousness, openness, and more narcissism. Consistent with Becker et al. (2013), there was no significant relationship between overall MMI score and extraversion or neuroticism. In support and expanding on Becker and colleagues' (2013) work, even after controlling for extraversion and neuroticism along with total media use, media multitasking still predicted trait depression, trait anxiety, and empathy levels. However, adding additional personality variables and controlling for total media use and all Big 5 traits resulted in media multitasking being a predictor of trait depression and empathy, but only approaching significance for trait anxiety. These results demonstrate the complexity of the relationship between a range of media multitasking behaviours and personality traits. It remains unclear whether engaging in these behaviours for a period of time encourages the development and maintenance of certain personality traits, or whether people with these personality traits tend to engage in more of these behaviours. Nevertheless, a prevalent relationship between the two is further established with results from this study.

Previous studies have already shown that the Big 5 and narcissism personality traits are associated with psychopathology and subjective well-being (e.g., Hayes & Joseph, 2005; Kealy et al., 2013; Kotov et al., 2010). However, no research has been done to connect the links between personality, psychosocial outcomes, and media multitasking behaviours. In the present study, I used mediation analyses to determine what role media multitasking plays within the relationship between personality and psychosocial outcomes. It was found that media multitasking partially mediated the relationship between personality traits of conscientiousness, agreeableness, and narcissism, and trait depression. Even though the direct relationship between openness and trait depression was not present, there was a significant indirect relationship through media multitasking behaviours. The results indicate that media multitasking behaviours partly explains the relationship between personality and trait depression. Similarly, the results demonstrated that media multitasking partially mediated the relationship between agreeableness and narcissism, and trait anxiety. There was an indirect effect between openness and trait anxiety even though the direct effect between these two variables was not significant. There was no mediating effect between conscientiousness and trait anxiety.

It may be that the expected association between openness and trait depression or trait anxiety is vulnerable to different interpretation because of the nature of the openness personality trait. According to the Big 5 model, openness involves seeking new experiences and intellectual curiosity, creativity, and attentiveness to inner feelings. Although these appear to be positive things, they can also manifest in behaviours that lead to negative outcomes. For example, seeking new experiences may be in the form of sensation seeking, which may lead to impulsive or dangerous behaviours such as substance use. Creativity may sometimes involve excessive fantasising or nonconformity to societal demands, which have other negative implications as well. Even attentiveness to inner feelings can be maladaptive if it results in rumination over negative feelings. Hence these could minimise the association between openness and trait depression or trait anxiety, even though there is still an indirect pathway between the two.

With these mediation results and the existing evidence of the linear relationships between these three variables, it could be suggested that enduring personality traits such as lower conscientiousness, agreeableness, openness and higher narcissism likely influences the engagement of media multitasking behaviours, which then contributes to more trait depression symptoms. Furthermore, those lower in agreeableness and openness, or higher in narcissism, who are more likely to participate in media multitasking, develop more symptoms of trait anxiety. This would be consistent with the Big 5 theory of personality which suggests that people with different personality traits are more likely to behave in certain ways (e.g., think negatively or get along with others) or engage in certain activities (e.g., go to social events or goal planning), and these can have implications on mental health and well-being.

Media multitasking also partially mediated the relationship between conscientiousness, agreeableness, openness, and narcissism, and empathy levels. It is possible that those with lower conscientiousness, agreeableness, openness and higher narcissism engage in more time media multitasking and therefore have reduced opportunity for or quality of meaningful interactions that would develop empathic skills, which in turn also facilitate meaningful interactions (Allemand, Steiger & Fend, 2014). In addition, time spent media multitasking may become a trade-off for face-to-face interaction, which is usually how people learn to develop empathy for others. This will be explored further in Chapter 4.

Interestingly, for the measure of general well-being (WBMMS), only a link between the sociability subscale, media multitasking, and personality was found. Media multitasking partially mediated the relationships between conscientiousness, agreeableness, and openness, and sociability. Although the mediating effects are very small, subjective well-being outcomes are influenced by such a large range of contributing factors (e.g., socioeconomic status, health, competence, culture; Diener, Oishi & Lucas, 2003; Pinquart & Sorensen, 2000) that media multitasking on its own would only be expected to have a small influence on the relationship between personality and subjective well-being. Further, this may also be part of the reason why a relationship was not found with total well-being or the other subscales. The WBMMS covers a range of well-being subscales, however this might mean that it covers the different aspects of a particular construct less broadly than a specific measure of, for example, happiness or life satisfaction, which has been used in other studies of subjective well-being.

Summary

Media multitasking has been shown to have negative associations with psychosocial outcomes such as trait depression, trait anxiety, and general well-being and empathy. In support of previous research, media multitasking was also found to be related to various personality traits. Findings also indicated that media multitasking explains some of the relationship between personality traits and psychosocial outcomes and it is therefore suggested that enduring personality traits provide a predisposition for engagement in media multitasking behaviours, which then contributes to negative psychosocial outcomes. In particular, the relationships between personality (conscientiousness, agreeableness, narcissism), media multitasking and empathy, trait anxiety, and trait depression appear to be the most robust. Based on what this study contributes to the literature and the existing evidence that is available, media multitasking should be engaged in cautiously given that it may contribute to poorer psychosocial well-being. In particular, those with certain personality traits should be more aware of their media multitasking behaviours as this may add on to their vulnerabilities for negative psychosocial outcomes.

STATEMENT OF CONTRIBUTION TO CO-AUTHORED PUBLISHED PAPER

The following chapter (Chapter 3) includes a co-authored paper. The bibliographic details of the co-authored paper, including all authors, are:

Lee, M., Murphy, K., & Andrews, G. (2018). Using media while interacting face-to-face is associated with psychosocial well-being, and personality traits. *Psychological Reports*. 1-24. doi: 10.1177/0033294118770357.

My contribution to the paper included:

- Selected measures for the research study in consultations with supervisors,
- Collected data for the research study,
- Conducted data analysis to produce the article,
- Review and interpretation of literature,
- Writing of the paper, and
- Identifying implications for future research.
- Making revisions based on reviewers' comments

We agree to the inclusion of the paper in this doctoral research submitted for examination. The journal in which this paper has been published in is peer-reviewed. Permission has been provided by the publisher, SAGE Publications Inc, to reproduce this paper as part of this doctoral thesis. Table numbers have been changed for the purposes of this thesis.

CHAPTER 3

USING MEDIA WHILE INTERACTING FACE-TO-FACE IS ASSOCIATED WITH PSYCHOSOCIAL WELL-BEING AND PERSONALITY TRAITS

Abstract

Positive face-to-face human interactions are known to benefit well-being. Drawing upon previous work regarding the interference of media (via technological devices or print) in social interaction, the aim of this study was to identify whether using media during face-to-face interaction limits the positive effect of interaction on well-being. Participants were 437 university students who completed an online survey which assessed media use and multitasking behaviours (Media Multitasking Index), well-being (trait depression, trait anxiety, social anxiety, empathy, psychological well-being), and personality traits (Big-5, and narcissism). Face-to-face interaction was positively associated with well-being. However, when media use during face-to-face interaction was considered, there was a negative relationship with well-being (more depression, more anxiety, less psychological well-being). Those who multitasked with certain media types, such as phone or video chatting, listening to music and gaming, while interacting with others, also had lower scores on measures of empathy. Regression analyses showed significant contributions by these media types to empathy levels, even after controlling for age, gender, and personality traits. Face-to-face media multitasking was related to higher levels of narcissism and neuroticism, and lower levels of agreeableness, conscientiousness and openness. This study provides insight into the link between face-to-face media multitasking and psychosocial outcomes.

Keywords: media multitasking, well-being, empathy, personality, face-to-face interaction

Face-to-face interaction and social relationships with others are associated with many psychosocial benefits, such as increased feelings of connectedness (Toepoel, 2013), increased levels of happiness (Leung et al., 2011), lower levels and risk of depression, and better overall health (e.g., Cruwys et al., 2013). However, the use of mobile technologies have changed the way people interact with others. People start using media devices from a young age (Giedd, 2012). In this article, “media” refers to content that is delivered through technological devices (e.g., mobile phone, computer, television) or print (e.g., magazines, newspapers). Media use results in increased screen-time and decreased face-to-face communication and activities (Giedd, 2012). This has raised concerns about the development and maintenance of face-to-face social skills in people of today’s society (Giedd, 2012). Thus, research attention has turned to media use during social interaction, in order to understand its relationship to well-being and other aspects of individual behaviour and functioning.

What is Media Multitasking?

Media multitasking has been defined in various ways. According to Ophir, Wagner and Nass (2009), it involves using at least two media forms concurrently. Others define media multitasking as using media whilst engaging in other non-media activities, such as interacting with others (e.g., Xu, Wang & David, 2016). In the current research, we adopted the latter definition including media activities (e.g., phone/video calls, social media, video gaming) use during face-to-face interaction. Given the increased accessibility of media for a range of activities (Rideout et al., 2010), media multitasking has become an increasingly common occurrence amongst children, young adults, and even older adults (Rideout et al., 2010). Large-scale studies show significant increases in the concurrent use of different media forms in young Americans (Bányai et al., 2017; Rideout, 2016; Rideout et al., 2010) and reports have identified young adults as being among the most connected Internet users (Madden, 2006). Hence, the influence of media multitasking during face-to-face interaction on psychosocial well-being has recently become an area of research interest. First, we outline a theory that accounts for media multitasking behaviors and how this could influence well-being.

According to the Adaptive Control of Thought and Rationale Theory (ACT-R; Anderson et al., 2004), people multitask by drawing resources from motor, perceptual or cognitive pools. While these pools can operate in parallel, within-pool demands are serial. Playing online/video games and watching TV/movies require similar sensory input (visual and auditory) to that used during face-to-face interaction (getting information about people from visual cues and auditory cues from verbal content of the conversation). Therefore it is difficult to effectively do both at the same time and would likely reduce the quality of interaction from one or both activities to the extent that media use during face-to-face interaction has an adverse input on personal relationships and overall well-being might be reduced. Thus, the current study seeks to add to the research by examining the links between media multitasking during face-to-face interaction on a range of psychosocial well-being facets by using this theory to explain these relationships.

Using Media While Interacting Face-to-Face Hurts Relationships and Well-Being

Social relationships, particularly face-to-face relationships, promote physical and emotional well-being (e.g., Reis et al., 2000; Uchino, Cacioppo & Kiecolt-Glaser, 1996), and a meta-analysis shows that the relationship between happiness and social relationships with quality face-to-face interactions is extremely robust (Lyubomirsky, King & Diener, 2005). As technology has become more prominent in people's lives, the nature of social relationships and the ways they are created and maintained has also changed. Currently, there is limited research that has explored the concurrent use of media and face-to-face interaction.

Therefore, this paper will first review studies that have focused on media use while interacting face-to-face, followed by a summary of other media use and media multitasking studies (without face-to-face interaction) that will build on the rationale for our current study and hypotheses.

A few studies have looked specifically at face-to-face media multitasking (i.e., use of media during face-to-face interaction). Mobile phone use at mealtimes with others (family, friends, associates) was found to be looked upon negatively by children and adults (Moser, Schoenebeck & Reinecke, 2016). Przybylski and Weinstein (2013) demonstrated that when strangers interacted in a controlled laboratory settings, perceived closeness, feelings of connection, and conversation quality were rated more negatively when mobile devices were present than when they were absent. This was particularly so when personally meaningful topics were being discussed. This was supported by another study that found people who texted during a conversation were rated by their companions as less polite and attentive, and the conversation quality was lower (Vanden Abeele, Antheunis & Schouten, 2016).

In a study investigating dyads engaging in a casual or meaningful 10-minute conversations in a coffee shop, Misra et al. (2016) showed that the presence (placing or holding) of mobile devices was related to lower levels of connectedness and empathic concern, regardless of age, gender, ethnicity or mood. These findings held regardless of the type of conversation (casual or meaningful). It appears even without active use, the presence of mobile devices has the potential to undermine individual face-to-face interactions by increasing the chances of overlooking nonverbal cues or expressions, missing changes in tone of voice, and reducing eye contact – all of which are important for fulfilling face-to-face conversations.

McDaniel and Coyne (2016) studied the interference of technology in romantic relationships of married women and women cohabiting with their partners, and the effect of this on personal and relationship well-being. It was found that interruptions in couple time (leisure, conversation, or meals) caused by technology were associated with increased conflict and lower relationship satisfaction. Those who perceived more frequent interruptions also showed poorer personal well-being such as greater depressive symptoms and lower life satisfaction. This was supported by Roberts and David (2016) who found that mobile phone use while in the company of a relationship partner can affect relationship satisfaction, particularly for those with anxious attachment styles. In addition, media multitasking behavior was found to indirectly influence depression scores through relationship satisfaction, and is supported by research in other cultures too (Wang et al., 2017). Amichai-Hamburger and Etgar (2016) investigated the association between smartphone multitasking and romantic intimacy. Although participants' self-reported smartphone multitasking scores were not related to romantic intimacy, their partners' scores were negatively related to romantic intimacy ratings. This implies that overall relationship quality is likely to decrease if either partner (or both) frequently engages in smartphone use while interacting face-to-face.

Hence, studies show that using media while interacting face-to-face has negative associations with social relationships and well-being outcomes, however no study has directly measured the link between this multitasking behavior across a range of media activities and an individual's psychosocial well-being. This study will fill this gap within the literature.

General Media Multitasking Is Also Linked to Negative Well-Being

A number of studies have investigated the link between media multitasking and aspects of psychosocial well-being. Becker, Alzahabi and Hopwood (2013) found that media multitasking was a unique predictor of self-reported symptoms of depression and social anxiety, even after controlling for personality traits (extraversion and neuroticism). The results suggest that personality traits may influence one's dispositional vulnerabilities to mood and anxiety problems whereas media multitasking might be an environmental factor that contributes to increased vulnerabilities to mood and anxiety problems.

The negative psychosocial outcomes of media multitasking have also been demonstrated in young girls aged between 8-12 years old (Pea et al., 2012). Higher levels of face-to-face communication were associated with positive socioemotional outcomes. Face-to-face interaction was negatively related to media multitasking, suggesting a trade-off relationship for young girls. Overall, video use, online communication and media multitasking were associated with negative socioemotional outcomes, including feeling less social success and normalcy, having more negative friendships, and sleeping less.

Other studies have specifically examined media multitasking during social interaction and how this affects psychosocial well-being. Xu et al. (2016) examined media multitasking and psychosocial well-being in university students. They distinguished social interaction as either synchronous (real-time interaction such as face-to-face, phone calls and video chatting) or asynchronous (e.g., texting and social networking sites). Media multitasking during synchronous, but not asynchronous, social interaction significantly decreased social success.

Media multitasking and psychological health in people aged between 14 to 85 years has also been investigated (Reinecke et al., 2016). In this study, internet multitasking referred to using the internet while engaging in other media or non-media activities, which could include face-to-face interaction such as a conversation, having a meal, interacting with a romantic partner, or going out with friends. Internet multitasking was related to more perceived stress, depression, and anxiety, particularly in the younger age groups (14 to 49 years). This is consistent with other studies in this area, and overall the research indicates that media multitasking is related to negative outcomes on social, emotional and psychological well-being in both adults and children (Becker et al., 2013; Pea et al., 2012; Reinecke et al., 2016; Xu et al., 2016).

Relationship Between Media Multitasking, Personality, and Well-Being

There are currently limited studies that have investigated only media use during face-to-face interaction and personality traits. However other general media multitasking studies (including a combination of both media and non-media activities) have found relationships with media multitasking behavior and personality traits such as impulsivity and sensation seeking (Duff et al., 2014; Jeong & Fishbein, 2007; Sanbonmatsu, 2013). The relationship between media multitasking and the Big 5 personality traits has hardly been researched and will be explored in the current study. Furthermore, a range of studies has found associations between Big 5 personality traits and depression, anxiety, and subjective well-being (Kotov et al., 2010; Steel et al., 2008). Narcissism has also been linked to psychopathology and poor psychosocial outcomes, particularly the maladaptive type (Calhoun et al., 2000), but has not been investigated in relation to media multitasking behaviors. Taken together, the relationship between face-to-face media multitasking, Big 5 and narcissism personality traits, and psychosocial well-being will be explored in the current study. In addition, since they appear to consistently influence one's vulnerability to experiencing poor well-being, these personality traits will be used as control variables to identify the unique contribution of face-to-face media multitasking to psychosocial well-being.

The Current Study

Previous research has shown positive effects of face-to-face interactions on well-being and negative effects of general media multitasking on well-being (Becker et al., 2013; Pea et al., 2012; Reinecke et al., 2016; Xu et al., 2016). The research suggests that media use while interacting face-to-face has a negative result on the positive benefits usually associated with social interaction (McDaniel & Coyne, 2016; Misra et al., 2016; Przybylski & Weinstein, 2013; Uhls et al., 2014). The current study further expands on the literature by examining the relationship between various types of media use while interacting face-to-face on a number of psychosocial well-being factors, including trait depression, trait anxiety, social anxiety, empathy, psychological well-being, and personality traits such as the Big-5 and narcissism. Following Becker et al. (2013), personality will be controlled for, given it can be a predisposition to subjective and psychological well-being (Anglim & Grant, 2016). It is hypothesized that face-to-face interaction will be positively related to well-being, but using media during face-to-face interaction will be negatively related to well-being (higher depression, anxiety, social anxiety, and lower empathy and general well-being). It is also expected that media use during face-to-face interaction will be related to different personality traits, and have different relationships with varying media activities.

Method

Participants and Procedure

A total of 437 participants (365 females, 72 males) took part in this study. Participants' mean age was 21.14 years (*SD* = 5.80, min = 17, max = 50). Although this is a large age range, 95% of participants were aged 36 and below. Given the imbalance of gender and large age range, both gender and age will be used as control measures in the analyses. Participants were undergraduates recruited through the Griffith University Research Participation Program who completed an online survey in return for course credit when they were enrolled in first year psychology courses. An information page was first provided and participants provided consent by continuing with the survey. The research protocol was approved by the Griffith University Human Research Ethics Committee.

Measures

Media use during face-to-face interaction. The Media Multitasking Index (MMI; Ophir et al., 2009) questionnaire measures media multitasking and total media use. Ralph and Smilek (2017) modified the MMI to include face-to-face interaction and other media activities. The current study adapted both questionnaires to include types of media that were more relevant to current trends in media use. Participants were asked how many hours of face-to-face interaction they engaged in on an average week. This was included in the analysis as "Face only". We examined face-to-face interaction while using 10 forms of media: reading print, texting/instant messaging, social media sites, non-social media sites, phone/video chatting, television, music, video/online gaming, emailing, and offline computer tasks. Participants rated this simultaneous media use and interacting face-to-face according to "Most of the time (1)," "Some of the time (0.67)," "A little of the time (0.33)," or "Never (0)." The 10 responses are summed then divided by the total number of hours face-to-face interaction to provide a measure of the amount of concurrent media used while interacting face-to-face. A higher score indicates that an individual spends more time using media while interacting with others face-to-face. The Face-to-Face Interaction Index (i.e., face-to-face media multitasking) represents the level of media multitasking an individual engages in during a typical hour of interacting face-to-face with a person. In the current study, Cronbach's alpha was .79, which is in the acceptable range.

Maryland Trait State Depression Scale – Trait Form (MTSD-T). The MTSD was developed based on the DSM-V criteria for depression (Chiappelli et al., 2014). It assesses depression and distinguishes current state symptoms from trait-like symptoms. The MTSD-T has 18 items. Participants answer both forms on a 5-point Likert scale. Responses on the trait-form are based on one's adult life except the past seven days, and ranges from 'never (1)' to 'experienced many times in a month for almost every month of my adult life (5)'. Higher scores indicate more depressive symptoms, with a range of 18 to 90. Test-retest validity and reliability were good (Chiappelli et al., 2014). In the current study, Cronbach's alpha was .94 which is in the excellent range.

State Trait Anxiety Inventory – Trait Form (STAI-T). The STAI (Spielberger et al., 1983) is a well-established measure of anxiety, separating state symptoms from more enduring trait-like symptoms. For the trait-form, participants respond to 20 statements based on how they generally feel. Participants rate themselves on a 4-point Likert scale ranging from 'almost never (1)' to 'almost always (4)'. Higher scores indicate more symptoms of anxiety, with a range of 20 to 80. Test-retest reliability for the trait scale was good, and its validity compared to other measures of anxiety was high (Spielberger et al., 1983). In the current study, Cronbach's alpha was .92 which is in the excellent range.

Interaction Anxiousness Scale (IAS). The IAS (Leary, 1983) is a 15-item measure of social anxiety. It considers both the social interaction and performance anxiety aspects of social anxiety. Participants rate themselves on statements on a 5-point Likert scale ranging from 'not at all characteristic of me (1)' to 'extremely characteristic of me (5)'. A higher score reflects more social anxiety symptoms, with a range of 15 to 75. The IAS demonstrated strong reliability and validity in data collected over 12 years (Leary & Kowalski, 1993). In the current study, Cronbach's alpha was .90 which is in the excellent range.

Toronto Empathy Questionnaire (TEQ). The TEQ (Spreng, 2009) is a 16-item measure assessing empathy as an emotional process. Participants rate themselves on a 5-point Likert scale ranging from 'never (1)' to 'always (5)' based on how frequently they felt or acted as described. Higher scores indicate higher levels of empathy, with a range of 16 to 80. Spreng (2009) showed that the TEQ had strong validity and test-retest reliability. In the current study, Cronbach's alpha was .88 which is in the good range.

Well-being Manifestations Measure Scale (WBMMS). The WBMMS is a 25-item questionnaire with six subscales measuring a combination of cognitive and affective components of psychological well-being, and a total well-being score (Masse et al., 1998b). The six subscales are: control of self and events, happiness, social involvement, self-esteem, mental balance, and sociability. Participants rate themselves on a 5-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, and 5 = always) based on their feelings and experiences during the last month. Higher scores indicate higher levels of psychological and total well-being, with a range of 25 to 125. Good reliability and validity has been found for the total well-being scale and its subscales (Masse et al., 1998a; Masse et al., 1998b). Cronbach's alpha was .95 which is in the excellent range.

Big 5 Inventory-10 (BFI-10). The 10-item scale (BFI-10) was developed by RAMMtedt and John (2007) including two items per subscale (extraversion, conscientiousness, agreeableness, neuroticism, openness). Each short-phrase item is rated on a 5-point Likert scale from 1 = disagree strongly to 5 = agree strongly. Higher scores show a stronger indication of that personality trait (ranging from 2 to 10 for each trait). Although this is a much shorter version of the original 44-item version, RAMMtedt and John (2007) showed that the BFI-10 still had good validity, reliability and internal consistency. In the current study, Cronbach's alpha for the subscales ranged from .31 to .61.

Narcissistic Personality Inventory-16 (NPI-16). The NPI-16 (Ames, Rose & Anderson, 2006) is a measure of narcissistic personality traits. It was developed to capture various facets of narcissism including self-ascribed authority, superiority and entitlement, and self-absorption. There are 16 item pairs where participants choose which statement of each pair described them best. Higher scores reflect higher levels of narcissism, ranging from 16 to 32. Reliability and validity has been found to be adequate (Campbell et al., 2002). Cronbach's alpha was .70 which is in the acceptable range.

Data Analysis

We will be employing correlational analyses to examine the link between using media while interacting face-to-face and psychosocial well-being. In addition, hierarchical regression analyses will be used to determine the unique contribution of using media while interacting face-to-face towards these psychosocial outcomes whilst controlling for age, gender, and personality traits. It is expected that higher amounts of media use while interacting with others would be related to poorer psychosocial outcomes.

Results

Correlations for Media Use During Face-to-Face Interaction (Face-to-Face Interaction Index)

Relationships between face-to-face interaction, media use, psychosocial well-being factors, and personality traits were examined using Pearson correlations. It was predicted that higher amounts of media multitasking during face-to-face interaction would be associated with poorer psychosocial outcomes. As hypothesised, higher media multitasking during face-to-face interaction was significantly correlated with higher trait depression, trait anxiety, and social anxiety, and less empathy (see Table 3.1). More media multitasking during face-to-face interaction was correlated with lower general well-being (as indicated by the WBMMS) including reports of less happiness, self-esteem, mental balance, and sociability (see Table 3.1).

These results show that when media is used during face-to-face interaction as opposed to pure face-to-face interaction, the relationship with psychosocial outcomes changed from a positive to negative relationship.

Table 3.1. *Correlations Between Media Multitasking, Depression, Anxiety, Social Anxiety and Empathy*.

Media type	Trait Depression	Trait Anxiety	Social Anxiety	Empathy	Overall well-being	Control of Self and Events	Happiness	Social Involve ment	Self-Esteem	Mental Balance	Sociability
Face only	-.15**	-.15**	-.12*	.17***	.20***	.14*	.19***	.15**	.14**	.20***	.20***
Face Index	.17**	.13**	.10*	-.23***	-.19*	-.04	-.11*	-.09	-.10*	-.12*	-.16**
Print media	.04	-.02	.01	-.16**	.06	.08	.05	.05	.06	.05	.02
Texting	.06	.07	.04	-.08	.01	-.05	.05	-.02	.01	.03	.02
Social sites	.11*	.14**	.08	-.08	.03	-.04	.06	.03	.01	.02	.06
Non social sites	.09	.08	.04	-.19***	-.03	-.01	-.03	-.02	-.02	-.01	-.07
Phone/video chatting	.01	-.04	-.09	-.28***	.02	.09	.03	-.02	.02	.03	-.09
Music	.10*	.003	-.07	-.23***	-.03	.02	-.03	-.04	-.02	-.05	-.07
TV/movies	.07	.10*	.09	-.12*	-.07	-.10*	-.04	-.07	-.05	-.01	-.10*
Video/online games	.09	.08	.02	-.36***	-.17***	-.13**	-.15**	-.12*	-.10*	-.15**	-.23**
Emailing	.03	-.02	-.09	-.20***	-.001	.03	.01	.04	.02	-.04	-.07
Offline computer tasks	-.02	-.11*	-.16**	-.22***	.08	.13**	.07	.08	.12*	.02	-.004

**p* <.05, ***p* <.01, ****p* <.001

Media use while interacting face-to-face was correlated with less extraversion, agreeableness, and conscientiousness personality traits. In addition, each personality trait was significantly related to more than one well-being outcome. These results are consistent with previous research, and therefore personality traits will be controlled for in the regression analyses later. Table 3.2 shows the statistics for these correlations.

Table 3.2. *Correlations Between Personality, Face-to-Face Index, and Psychosocial Outcomes*

Media type	Trait Depression	Trait Anxiety	Social Anxiety	Empathy	Overall well-being	Face Index
Extraversion	-.25***	-.40***	-.61***	.13**	.41***	-.16**
Agreeableness	-.23***	-.23***	-.17***	.35***	.23***	-.14**
Conscientiousness	-.34***	-.35***	-.22***	.26***	.36***	-.10*
Neuroticism	.48***	.65***	.67***	.02	-.52***	.01
Openness	-.04	-.06	-.11*	.13**	.10*	-.08
Narcissism	-.12*	-.20***	-.31***	-.13**	.17***	.06

**p <.05, **p <.01, ***p <.001*

Using Different Media Types While Interacting Face-to-Face and the Relationship with Depression, Anxiety, and Empathy.

Further analyses were conducted to identify relationships between using ten different media types (each item from the MMI) during face-to-face interaction and the psychosocial outcomes (See Table 3.1). It was expected that the use of technological devices such as mobile phones (e.g., texting, phone chatting), and social media, while interacting with others would be most strongly related to poorer psychosocial outcomes. Results partially supported the hypothesis and showed that using social media or listening to music during face-to-face interaction were associated with higher levels of trait depression. Using social media and watching TV or movies while interacting face-to-face were linked with higher trait anxiety.

Doing offline computer tasks while interacting face-to-face was related to lower trait anxiety and social anxiety. Using non-social sites, reading print, phone/video chatting, listening to music, watching TV/movies, playing online/video games, emailing and doing offline computer tasks while interacting face-to-face were all related to lower levels of empathy.

Using Different Media Types while Interacting Face-to-Face and the Relationship with Psychological Well-Being (WBMMS).

Based on previous research it was expected that using mobile devices and social media while interacting face-to-face would be most strongly related to poor general well-being. Results did not support the hypothesis, and instead showed that increased time playing online/video games while interacting face-to-face showed negative relationships with overall psychological well-being (WBMMS), and the subscales control of self and events, happiness, social involvement, self-esteem, mental balance, and sociability. More TV/movie watching during face-to-face interactions was associated with lower control of self and events and sociability scores. In contrast, interacting face-to-face while doing offline computer tasks was related to higher control of self and events and self-esteem scores. Refer to Table 3.1 for relationships between different combinations of media multitasking and psychological well-being.

Regression Analyses for the Contribution of Media Use During Face-to-Face Interaction for Depression, Anxiety, and Empathy Scores.

The relationship between face-to-face interaction with media multitasking and psychosocial well-being was further explored by running separate hierarchical regression analyses using trait depression, trait anxiety, social anxiety, empathy, and overall well-being as the dependent variables. These psychosocial variables were selected because of the correlations with face-to-face interaction media multitasking (overall and different media types). Predictors were entered into the regression analysis in two steps. The first step entered age, gender, Big-5 personality variables and narcissism. The next step entered the Face-to-Face Index score. This approach allows us to determine whether overall use of media during face-to-face interaction adds a unique contribution after controlling for demographic and dispositional factors such as age, gender, and personality traits.

At Step 1, the overall model for trait depression was significant, $F(8, 428) = 22.13$, $p < .001$. After controlling for age, gender, and personality, the Face-to-Face Index was still a unique contributor to trait depression, $F(9, 427) = 21.68$, $p < .001$), explaining an extra 2% variance. Refer to Table 3.3 for the regression statistics for this model.

Table 3.3. *Hierarchical Regression Models Predicting Trait Depression.*

	R	R^2	R^2 Change	β
Step 1 (Age, gender, personality)	.54	.29***		
Age				.04
Gender				-.06
Narcissism				.24
Extraversion				-.03
Agreeableness				-.12**
Conscientiousness				-.21***
Neuroticism				.37***
Openness				.02
Step 2 (Face-to-Face Index)	.56	.31***	.02***	.15***
Step 2 (Print media)	.55	.30	.01	.07
Step 2 (Texting)	.54	.29	<.001	<.001
Step 2 (Social sites)	.54	.29	.001	.04
Step 2 (Non-social sites)	.54	.30	.003	.06
Step 2 (Phone/video chatting)	.54	.29	<.001	.02
Step 2 (Listening to music)	.55	.30	.01	.08

Step 2 (Watching TV/movies)	.54	.29	<.001	-.02
Step 2 (Video/online games)	.54	.29	.002	.04
Step 2 (Emailing)	.54	.30	.002	.05
Step 2 (Offline computer tasks)	.54	.29	.001	.03

**p <.05; **p<.01; ***p<.001*

The model for trait anxiety at Step 1 was significant as well, $F(8, 428) = 50.70$, $p < .001$. Using the same control variables, the Face-to-face Index was a significant contributor to trait anxiety, $F(9, 427) = 46.56$, $p = .01$, accounting for an additional 1% of the variance. Refer to Table 3.4 for the regression model for trait anxiety.

Table 3.4. *Hierarchical Regression Models Predicting Trait Anxiety.*

	R	R^2	R^2 Change	β
Step 1 (Age, gender, personality)	.70	.49***		
Age				-.03
Gender				-.04
Narcissism				-.06
Extraversion				-.13**
Agreeableness				-.10**
Conscientiousness				-.15***
Neuroticism				.52***
Openness				.02
Step 2 (Face-to-Face Index)	.70	.50**	.01**	.10**
Step 2 (Print media)	.70	.49	<.001	.02
Step 2 (Texting)	.70	.49	<.001	-.01
Step 2 (Social sites)	.70	.49	.002	.05
Step 2 (Non-social sites)	.70	.49	.002	.05
Step 2 (Phone/video	.70	.49	<.001	<.001

chatting)				
Step 2 (Listening to music)	.70	.49	<.001	-.01
Step 2 (Watching TV/movies)	.70	.49	<.001	-.02
Step 2 (Video/online games)	.70	.49	<.001	.02
Step 2 (Emailing)	.70	.49	.001	.03
Step 2 (Offline computer tasks)	.70	.49	.002	-.04

**p <.05; **p<.01; ***p<.001*

The model for empathy at Step 1 was also significant, $F(8, 428) = 15.99$, $p < .001$. The Face-to-face index also significantly contributed to lower empathy levels by accounting for an extra 1% of the variance even after controlling for age, gender and personality, $F(9, 427) = 15.26$, $p = .01$ (see Table 3.5).

Table 3.5. *Hierarchical Regression Models Predicting Empathy.*

	R	R^2	R^2 Change	β
Step 1 (Age, gender, personality)	.48	.23***		
Age				.12*
Gender				-.11*
Narcissism				-.08
Extraversion				.14**
Agreeableness				.28***
Conscientiousness				.18***
Neuroticism				.18***
Openness				.10*
Step 2 (Face-to-Face Index)	.49	.24**	.01**	-.12**
Step 2 (Print media)	.50	.25**	.02**	-.14**
Step 2 (Texting)	.48	.23	.00	-.01
Step 2 (Social sites)	.48	.23	.00	-.07

Step 2 (Non-social sites)	.49	.24*	.01*	-.10*
Step 2 (Phone/video chatting)	.51	.26***	.03***	-.19***
Step 2 (Listening to music)	.51	.26***	.03***	-.18***
Step 2 (Watching TV/movies)	.49	.24	.01	-.07
Step 2 (Video/online games)	.53	.28***	.05***	-.25***
Step 2 (Emailing)	.51	.26***	.03***	-.17***
Step 2 (Offline computer tasks)	.51	.26***	.03***	-.18***

**p <.05; **p<.01; ***p<.001*

Media use while interacting face-to-face was not a unique predictor of social anxiety after age, gender, and personality were controlled for (p = .13, see Table 3.6). At Step 1, the model for social anxiety was significant, $F(4, 428) = 81.88$, $p < .001$. At Step 2, the Face-to-face index contributed 0.2% extra variance, $F(9, 427) = 73.21$, $p = .14$, which was not significant.

Table 3.6. *Hierarchical Regression Models Predicting Social Anxiety.*

	R	R^2	R^2 Change	β
Step 1 (Age, gender, personality)	.78	.61***		
Age				-.05
Gender				-.05
Narcissism				-.10**
Extraversion				-.39***
Agreeableness				-.07
Conscientiousness				-.02
Neuroticism				.47***
Openness				-.01
Step 2 (Face-to-Face Index)	.78	.61	.002	.05

Step 2 (Print media)	.78	.61	.002	.04
Step 2 (Texting)	.78	.61	<.001	-.01
Step 2 (Social sites)	.78	.61	<.001	.02
Step 2 (Non-social sites)	.78	.61	<.001	.002
Step 2 (Phone/video chatting)	.78	.61	<.001	-.01
Step 2 (Listening to music)	.78	.61	.002	-.04
Step 2 (Watching TV/movies)	.78	.61	.001	-.03
Step 2 (Video/online games)	.78	.61	<.001	-.02
Step 2 (Emailing)	.78	.61	.001	-.03
Step 2 (Offline computer tasks)	.78	.61*	.01*	-.08*

**p <.05; **p<.01; ***p<.001*

Separate regressions were then run for each use of media type during face-to-face interaction using the same control variables. With the exception of listening to music, which approached significance when predicting trait depression, $F(9, 427 = 20.16$, $p = .07$, none of the media types made significant contributions to trait depression (all $Fs < 19.94$, all $ps > .10$) or trait anxiety (all $Fs < 45.34$., all $ps > .10$). Media use while doing offline computer tasks was a significant contributor to social anxiety, $F(9, 427 = 74.34$, $p = .01$. Refer to Tables 3.3, 3.4, and 3.6 for regression statistics for trait depression, trait anxiety, and social anxiety.

Using empathy levels as the dependent variable, the same control variables were entered into Step 1. Each media activity during face-to-face interaction was then entered into a separate analysis at Step 2. The results from these regression analyses are presented in Table 3.5. Although age, gender and personality were significant predictors of empathy, using print media, non-social sites, phone/video chatting, listening to music, playing video/online games, emailing, and offline computer tasks while having face-to-face interaction made significant unique contributions to empathy levels (all *Fs* > 14.90, all *ps* < .02).

Regression Models for Overall Well-Being as Measured by the WBMMS.

The same control variables were used in Step 1 as the previous regression analyses. This model was statistically significant, $F(8, 428) = 31.63$; $p < .01$, and accounted for 37.2% of the variance for overall well-being. Face-to-face Index was added at Step 2 and showed no significant contribution to overall well-being as measured by the WBMMS ($p = .16$). Each media type while interacting face-to-face was added into a separate analysis at Step 2. Only social sites ($F(9, 427) = 29.01$; $p <.01$) and video/online gaming ($F(9, 427) = 29.26$; $p <.01$) during face-to-face interaction were found to be significant contributors to overall well-being. Each accounted for an additional 1% of the variance. Refer to Table 3.7 for the regression statistics for overall well-being

Table 3.7. *Hierarchical Regression Models Predicting Overall Well-being.*

	R	R^2	R^2 Change	β
Step 1 (Age, gender, personality)	.61	.37***		
Age				-.05
Gender				.02
Narcissism				.04
Extraversion				.20***
Agreeableness				.11**
Conscientiousness				.21***
Neuroticism				-.35***
Openness				.04
Step 2 (Face-to-Face Index)	.61	.38	.01	.07
Step 2 (Print media)	.61	.37	<.01	.04
Step 2 (Texting)	.61	.38	.01	.08
Step 2 (Social sites)	.62	.38*	.01*	.10*
Step 2 (Non-social sites)	.61	.37	<.01	.01

Step 2 (Phone/video chatting)	.61	.37	<.01	.00
Step 2 (Listening to music)	.61	.37	<.01	-.02
Step 2 (Watching TV/movies)	.61	.37	.002	.04
Step 2 (Video/online games)	.62	.38**	.01***	-.11***
Step 2 (Emailing)	.61	.37	.001	-.03
Step 2 (Offline computer tasks)	.61	.37	.001	.04

*p <.05; **p<.01; ***p<.001

Discussion

This study explored the relationship between using various media forms while interacting face-to-face and a range of well-being measures. As expected, time spent on face-to-face interaction by itself was associated with lower trait depression, trait anxiety and social anxiety scores. It was also related to higher levels of empathy and psychological well-being. These results support previous studies showing psychosocial benefits of interacting with others (e.g., Cruwys et al., 2013; Leung et al., 2010; Toepoel, 2013). When face-to-face interaction occurred concurrently with media use, these relationships were negative, suggesting that the inclusion of media use may not only hinder the positive effects of face-to-face contact, but even contribute to negative psychosocial well-being. This is consistent with the hypotheses and previous studies showing that media multitasking during social interactions decreased aspects of well-being, such as social success and feelings of normalcy (e.g., Pea et al., 2012). However, these previous studies did not assess the same psychosocial well-being factors that were examined in this study, including trait depression and anxiety, social anxiety, and empathy. Therefore this study expands the current knowledge on the links between using media while interacting face-to-face and psychosocial well-being.

Although the regression analyses did not show overall face-to-face media multitasking to be a significant unique contributor of social anxiety, it was for trait depression and trait anxiety. While we acknowledge that the contribution is small, that is to be expected given the multitude of known contributing factors to depression and anxiety. Nevertheless, it suggests that people who use media while interacting with others may be increasing their risk to depression and anxiety, likely through poorer relationship quality. However, it is also a modifiable behavior that can be managed more readily (versus genetic or personality predispositions) and therefore reduce the additional risk of depression and anxiety. The findings from this study partially support and expand the work of Becker et al. (2013). The differences in results for social anxiety could be due to a larger number of controlled variables such as age, gender and more personality traits in this study, compared to just extraversion and neuroticism in the Becker et al. (2013) study. Further, Becker et al. (2013) measured social anxiety and used a screener for state depression. This study adds to the existing research by using a trait anxiety and trait depression measure and showing that the negative influence of media use during face-to-face interaction is not limited to a specific anxiety or state depression only.

Partially supporting the hypotheses, using different media during face-to-face interaction was found to be related to various positive and negative psychosocial outcomes. Using social media and playing online/video games while interacting face-to-face were significant predictors of poorer overall psychological well-being as measured by the WBMMS. Most studies have found social interaction to be beneficial to well-being (e.g., Toepoel, 2013) and some studies also suggest using social media lowers depression due to the social connections involved (Houston, Cooper & Ford, 2002). However, the current results suggest that an individual communicating face-to-face and through social media at the same time is unable to reap the benefits of both, or either one. This may indicate that the quality of social interaction is more important to measures of well-being than just the presence of another person, and using media during interpersonal interaction reduces its quality. One explanation for these results could be that when a person uses these forms of media while interacting with others, there is a trade-off on the quality of interaction due to conflicting use of cognitive resources, as previous studies have observed (Misra et al., 2014; Przybylski & Weinstein, 2013). This is consistent with the Adaptive Control of Thought and Rationale Theory (ACT-R; Anderson et al., 2004), which would support that media multitasking while interacting face-to-face would be difficult to do effectively. This is because face-to-face interaction usually involves visual and/or auditory cues, which take up resources from those pools. Media activities often also require resources from the visual and/or auditory pools (e.g., watching a movie or listening to music); therefore clash with the resources needed during face-to-face interaction. Although relationship or conversation quality was not directly measured in the current study, it is possible that the concurrent use of media such as social media while interacting with others contributes negatively to interpersonal relationships, and over time, contributes to an increase in depression and anxiety, and a decrease in overall well-being. This is consistent with previous research showing a negative association between media use, relationship quality and well-being (McDaniel & Coyne, 2016; Misra et al., 2016; Przybylski & Weinstein, 2013; Uhls et al., 2014).

The results also provide evidence that those who use media while interacting with others face-to-face have lower levels of empathy. It is unclear whether people with lower levels of empathy are more likely to engage in media activities while talking to others, or whether engaging in these activities leads to reduced opportunities to develop empathic social skills. The latter would support results from Uhls et al. (2014) showing improved social and emotional perception skills in children when they participated in outdoor camp without media devices. Nevertheless, this also suggests that continued face-to-face media multitasking is likely to further diminish empathic skills over time simply from lack of development and practice. As a result, lower levels of empathy would likely impact on relationship quality (Lopes, Salovey & Straus, 2003), affecting one's feelings of social connectedness, social support, thus reducing well-being and increasing the risk of mental health issues. The current results further support this by showing that even after controlling for age, gender, and personality factors, a number of types of media used during face-to-face interaction still predicted lower levels of empathy. This is the first study to have examined the link between face-to-face media multitasking and empathy in individuals, and provides us with additional information about how face-to-face media multitasking can negatively influence relationships and well-being, given that empathy has been shown to be an important element for both (Carnicer & Calderon, 2014; Levesque et al., 2014).

Interestingly, doing offline computer tasks while interacting face-to-face was related to lower social anxiety and higher feelings of control of self and events and mental balance. One possible explanation is that the sample was university students, who are likely to engage in collaborative group discussions or study groups with peers. This presents an opportunity for social interaction that includes a common conversational topic for each member. This could facilitate positive social experiences, increase feelings of control and mental balance, as well as reduce social anxiety. Likewise, in a workplace setting, performing offline computer tasks alone may be isolating and boring. However, interacting with colleagues can improve workplace relationships, social connectedness, and individual well-being (Colligan & Higgins, 2006).

One potential limitation of this study is the imbalance of gender within the sample as there were five times more females than males. While some studies show no gender differences in internet use or television viewing (Gross, 2004; Hunley et al, 2005), some studies have shown gender differences in internet use (e.g., Ohannessian, 2009). It has been suggested that males mainly use the internet for entertainment and leisure while females are more likely to use it for interpersonal communication and educational assistance (Ohannessian, 2009; Weiser, 2000). In the current study, gender was found to be related to a few variables including empathy, narcissism, and neuroticism. Therefore, gender was used as a control measure in the analyses. Although gender difference is not the focus of the current study, further research could include a more gender balanced sample and identify gender differences in media use during face-to-face interaction, and how this might be related to psychosocial outcomes. Further, although a large age range is present in the sample, the majority of participants were clustered in the same age group, and results did not differ when older participants were excluded from the analyses. However, age overall was related to trait anxiety, social anxiety, empathy, conscientiousness, neuroticism, and openness. Therefore, age was also used as a control measure in the analyses.

While we acknowledge the limitations of using single-item measures, we approached our analyses of different types of media in an exploratory manner and cautiously interpret its results. However, the results are still of some value as they provide insight that perhaps using certain types of media while interacting with others may not be as bad as others. This can help to reduce the overgeneralization that all media multitasking is bad, and encourages future research to look at other types of media multitasking in more detail.

Overall, the results from this study suggests that using media while interacting face-to-face with others could counteract the positive effects of social interaction, and has negative implications on well-being. This implies that the quality of interaction plays an important role in psychosocial well-being, rather than just face-to-face presence. It is also important to consider the type of media being used when interacting with others, and the setting this is occurring in, as they have varying effects on psychosocial well-being. Entertainment and leisure-type activities such as listening to music, social sites, watching TV/movies, and playing games while interacting with others appears to have negative well-being outcomes, while work-related activities such as offline computer tasks are related to positive well-being outcomes. In addition, the results indicated more media multitasking while interacting face-to-face to be a predictor of lower empathy levels. Based on previous research (Carnicer & Calderon, 2014; Lopes et al., 2003), it is likely that this would contribute to poorer relationship quality, and in the long-term well-being would suffer due to less social support and sense of connectedness (McDaniel & Coyne, 2016; Misra et al., 2016; Pea et al., 2012; Przybylski & Weinstein, 2013; Uhls et al., 2014). Media use while interacting face-to-face predicts negative psychosocial outcomes, with the exception of a few media types. Therefore engaging in this behavior should be reconsidered if possible, particularly in excessive amounts.

CHAPTER 4: STUDY 2

SELECTION OF STIMULI FOR THE ATTENTIONAL TASKS USED IN STUDY 3

The aim of Study 2 was to obtain a face and word stimulus set that are comparable to each other and suitable for use in Study 3. A reason for the rating of emotional words in the current study was to ensure comparability with the happy, angry, and neutral emotional faces that were used in Study 3. There are currently no established happy/angry-word lists that are comparable to databases of happy/angry facial expressions of emotions that have been used in various studies (e.g., NimStim Face Stimulus Set, Tottenham et al., 2009). Various extensive word lists such as the Affective Norms for English Words (ANEW, Bradley & Lang, 1999), work by Anderson (2005) and Neshat-Doost (1999) have been created, but the basis on which the words were measured on does not address the type of words needed (happy/angry/neutral) for Study 3. It is important that a high agreement rating is obtained to ensure the definition of the word represents a happy or angry emotion, and that the neutral words do not define any emotion. As there have not been any studies using an established list of happy/angry emotion words, this study will fill in the gap by rating words based on their definition of the happy, angry and neutral emotions.

I will first outline the process of selecting face stimuli from an existing and well-established database. Following that, the chapter will explain the need for rating word stimuli that closely resembles the criteria used for selecting face stimuli, given that what is currently available was not the most suitable for use in Study 3. The collection of word ratings and analyses will then be discussed.

Selection of Face Stimuli

Face stimuli were selected from the NimStim Face Stimulus Set (Tottenham et al., 2009). The database has previously been evaluated as a set of facial expressions that untrained individuals would recognize. The overall validity and reliability of the face stimuli was reported to be high (.81 and .84 respectively) and comparable to other well-established face databases such as the Pictures of Facial Affect (Ekman & Friesan, 1976). Refer to Table 4.1 for the validity and reliability ratings for each emotion category relevant for use in Study 3 as reported by Tottenham et al. (2009). Given that the NimStim database is well-established and has been used in many studies, additional ratings are not necessary for these stimuli. The NimStim Face Stimulus Set was chosen because different facial expressions (i.e., happy, angry and neutral) are available for the same actors. Additionally, all faces are photographed from a frontal view, which reduces inconsistency caused by different angles and lighting.

Pictures were edited to black and white to reduce and identifying features such as hair or eye colour. To further minimize the possibility that participants might select faces based on features that stand out, faces with excessive facial hair and darker skin colour were removed from the face set. Faces with emotional expressions exposing teeth were also removed from the face set as these would likely contribute to the capturing of attention when presented along with neutral distractor faces. A total of 10 different faces for each emotional category (happy, angry, neutral) were selected as targets. The actors portraying the expressions remained the same across target emotional categories. A further 20 neutral faces portrayed by different actors than the target faces were selected as neutral distractors. For both target and distractor faces, half were male and half were female. A one-way ANOVA was conducted to compare the proportion correct scores (obtained from Tottenham et al., 2009) of the selected face stimuli. Results showed no significant differences, $F(3, 49) = .54$, $p = .66$, with post-hoc analyses showing no significant differences between each category (all $ps = 1.00$). Figure 4.1 and 4.2 shows examples of a facial expression from each category.

Table 4.1. *Validity and reliability for happy, angry and neutral faces (closed-mouth)*

Emotion	Validity		Reliability
	M	*SD*	Agreement between Blocks 1 and 2
Happy (closed)	.92	.07	.91
Angry (closed)	.84	.17	.87
Neutral	.91	.06	.94

Figure 4.1. Example of happy, angry and neutral target faces by the same actor from the NimStim Face Stimulus Set. (Permission has been granted to publish actor #45, https://www.macbrain.org/resources.htm)

Figure 4.2. Example of a neutral distractor face stimulus from the NimStim Face Stimulus Set. (Permission has been granted to publish actor #3, https://www.macbrain.org/resources.htm)

The selection of face stimuli in this study was completed after elimination of faces that could potentially "pop-out" if they were used in an attentional task. The final face stimuli set consisted of 10 happy, 10 angry, 10 neutral target faces of the same actors, as well as 20 neutral distractor faces of actors different to the target faces. Target faces were actors #1, 5, 7, 8, 9, 22, 26, 30, 34, and 45. Neutral distractor faces were actors #2, 3, 6, 10, 13, 15, 16, 17, 18, 19, 21, 23, 24, 28, 29, 32, 33, 36, 37, and 42. Each group had an equal number of male and female faces to reduce gender biases in face recognition, which has previously been shown (Herlitz & Loven, 2013). As the full NimStim Face Stimuli Set has already been well-established and previously rated (Tottenham et al., 2009), no further ratings were done in this study.

Rationale for Emotional Word Rating

Numerous studies have used word stimuli in attentional tasks such as the dot probe, visual search, and attentional blink tasks to examine attention differences towards emotional and neutral words (e.g., Arend & Botella, 2002; Koster et al., 2009; Sutton & Altarriba, 2011). However, across the studies there have been inconsistencies in the types of words used and the words are generally not specific to any particular category of emotion. For example, some studies have used words like *sunshine* that fit into broader categories such as positivity or pleasantness (e.g., Keil, Ihssen & Heim, 2006) while other studies used words like *cancer* that were related to specific conditions such as mental health or illness (e.g., Vassilopoulous, 2005). The aim of this study is to generate lists of emotional (happy and angry) and neutral words that are representative of these emotions. These word stimuli will be used in attention tasks for Study 3 which will compare the performance on the dot-probe, visual search, and attentional blink tasks of people rated as HMM, AMM, and LMM, using happy, angry and neutral faces and words.

Existing word databases and word lists

The Affective Norms for English Words (ANEW) by Bradley and Lang (1999) is a large-scale word rating study that was conducted with university students and has been widely used in a range of studies (e.g., Helfinstein et al., 2008). Words were rated on three facets: valence (pleasant to unpleasant), arousal (calm to excited), and dominance (feeling in control to feeling controlled). Consequentially these word ratings are not suitable for use in selecting the word stimuli for Study 3 as emotion specific words are needed (happy, angry and neutral). As valence was rated on a continuum of pleasant to unpleasantness, the word list could contain words representative of a range of emotions including happiness (e.g., joy), sadness (e.g., depression), anger (e.g., angry), fear (e.g., afraid), disgust (e.g., disgusted) and many other secondary emotions. Some pleasant or unpleasant words could even fall into multiple emotion categories. Study 3 requires word stimuli that are clearly comparable to happy, angry, and neutral facial expressions, thus words need to be categorised based on the definition of the happy, angry, and neutral emotions only, rather than being rated on a continuum of pleasantness. The ANEW also includes a large number of words that are strongly valenced (either pleasant or unpleasant) based on associations to other concepts and not based on the word meaning itself (e.g., holiday, money, prison, ulcer). These types of words cannot be used in Study 3 because they would not be representative of the happy and angry emotions even though they were strongly positively or negatively valenced in the ANEW.

A study by Neshat-Doost et al. (1999) produced emotional word lists by asking 221 primary and secondary school students to imagine feelings and write down words. These feelings included happiness, sadness, fear, feeling good about yourself, and feeling bad about yourself. According to the instructions, children listed both descriptions of the feelings, as well as things that invoke those feelings. Each category was compiled using the 25 most commonly generated words in that category. These word lists were not considered suitable for Study 3 for several reasons. Participants were children and adolescents, which is a different population to the university student sample that will take part in Study 3. This may present differences in commonly used vocabulary and familiarity with emotional terms. Further, the inclusion of words representing things that invoke feelings creates subjectivity and most likely differences between children and adults given the difference in life experience and things of interest (e.g., teddy vs champagne). Finally, their neutral word list only contained animals, and there was no word list created to portray the angry emotion, which is necessary for Study 3.

Although some studies matched emotional words with neutral words in length and frequency (Anderson, 2005; Dalgleish et al., 2001; Mansell, 2002), in many studies the words were not rated prior to the experiment to ensure the words were representative of the emotion for the sample population (e.g., Arend & Botella, 2002; Koster et al., 2005; MacLeod, Mathews & Tata, 1986; Mansell & Clark, 1999; Mathews & MacLeod, 1985). These word lists have often been used in later studies with the assumption that they are valid for the current population and sometimes generalised to be appropriate for specific word categories (e.g., Mansell et al., 2002; Neshat-Doost et al., 2000). For example, Neshat-Doost et al. (2000) reported using words from their earlier study (Neshat-Doost et al., 1999) and categorised them into physical and social threat words. However, the words were not rated this way in the previous study, therefore there is no evidence to support the categorisation of those physical and social threat words. In several studies, target words were only selected by clinicians who were considered experts in treatment of a particular disorder (e.g., Asmundson & Stein, 1994; Dalgleish et al., 2001). Following this, numerous studies have used such word lists for further study (e.g., Mansell et al., 2002; Vassilopoulos, 2005). The disadvantage of this would be that participants who are not clinicians may have different interpretations and associations for these words, therefore affecting its validity. For example, participants might be unfamiliar with the technical terms commonly used by clinicians. Hence this could reduce the understanding and personal relevance associated with the word, and minimize the potential for significant attentional bias effects. This study will overcome this limitation of many previous studies by having words rated by a sample of participants that will be similar to the sample recruited for Study 3.

In many studies the emotional words are selected because they are classified as positively or negatively valenced words because they represent positive or negative associations. For example, in Anderson (2005), the word *beauty* is categorized as a positive word while the word *crisis* is categorized as a negative word. However, both of these words can only be put in these categories when associated with a person, object, or event. On the other hand, *excited* and *angry* were also in Anderson's (2005) positive and negative word list, respectively. These words define an emotion without association, broadly, the happy and angry emotions. These types of words are more appropriate for use in Study 3 because they represent an emotion and would be comparable to the emotional expressions on face stimuli that will be used. Therefore, although Anderson (2005) collected a sizeable word list, the words have been defined by positivity rather than specific emotions, and are unsuitable for use in Study 3 without additional rating and categorization studies. This study will use some emotive words from Anderson's list and collect happy/angry/neutral categorization ratings to ensure the words are suitable for use in Study 3.

Words used in previous dot-probe, visual search, and attentional blink tasks

Furthermore, across various studies and experiments, emotional words have been defined differently and different types of words have been used even when they are similarly categorized (e.g., positive or pleasant). For their attentional blink task, Mathewson, Arnell and Mansfield (2008) chose words and Keil et al. (2006) used verbs only based on emotional pleasantness. For example, *vacation* was considered pleasant/positive (Mathewson et al., 2008) and *to hug* was considered an emotionally pleasant verb (Keil et al., 2006). However, both studies did not define pleasant emotions such as happiness, and they required association to experiences before putting into the emotionally pleasant or unpleasant category. Some studies compared specific types of threat-related words to neutral words in a dot-probe task. For example, Mogg et al. (2000) used physical threat, social threat and neutral household-related words in their study comparing participants with and without anxiety. Other dot-probe studies have used similar threat words (Asmundson & Stein, 1994; Vassilopoulous, 2005), and some have included words that are related to clinical symptoms such as depression-related or anxiety-related words (Dalgleish et al. 2001; Neshat-Doost et al. 2000; Bradley, Mogg & Lee, 1997). Rinck et al. (2003) used anxiety-related, positive, and neutral words in their visual search, and Shields and Murphy (2011) included health-related, general negative, general positive, and neutral words in their visual search with high and low anxious participants. Although threat-words have been used in a number of different attentional studies, these words do not specifically represent the emotions of anger or happiness. A threat-word could encompass a variety of emotionally-laden words that are related to anger, fear, disgust, and other secondary emotions. Word lists from the aforementioned studies are uniquely selected for that study and use different word types that cannot be replicated for Study 3 because they are not representative of the happy, angry and neutral emotions. A separate word list will be created in the current study to address this as words will be rated based on the meaning of an emotion and its intensity. This is important to ensure that the word lists are representative of specific emotions so that when used in Study 3, it can be indicative of attentional biases towards these emotions.

Word arousal levels

In addition to emotional valence, previous studies have noted the importance of considering word arousal levels. Keil and Ihssen (2004) manipulated word valence and arousal in their attentional blink task. They selected words that were high in arousal and strongly valenced (either very pleasant or very unpleasant) to be target words. Neutral words and distractors were words with both low arousal and low valence. They found that with high arousal verbs captured attention better than lower arousal verbs. Results from Anderson (2005) supported and expanded on these findings. Over several attentional blink experiments, Anderson (2005) used positive, negative, positive-arousing and negative-arousing words of a sexual nature. Based on the results, it was suggested that arousal enhances encoding of stimuli, and produces a more powerful effect on attention when compared to lower arousal emotional words (Anderson, 2005).

As the current study aims to rate words that are representative of a specific emotion, it would be more suitable to measure the emotional intensity rather than arousal level. Ideally, target emotion words should have emotional intensity that is significantly higher than neutral words. However, an extremely intense word may have a “pop-out” effect regardless of which type of emotion the word is, due to the enhanced encoding similar to high arousal words. This might interfere with the processing of emotion and subsequent attentional biases observed, if any. Therefore, words that have a very high mean intensity rating would be considered not ideal for use in Study 3 and were therefore excluded from the stimulus set.

Method

Participants and Procedure

Twenty-three first year psychology undergraduate participants took part in a pilot online word rating survey in return for one hour course credit. Students were not required to reveal their age or gender. Participants were asked to categorize 260 words into the emotional categories of either *happy, angry, neutral,* or, *other* based on the category that best represented that word (Refer to Appendix Table A1 for full word list). An Oxford thesaurus (Waite, 2012), the Anderson (2005) word list, ANEW (Bradley & Lang, 1999) database, and Clore, Ortony and Floss' (1987) affective condition list were screened for words that were synonymous with *happy* and *angry.* Neutral words were selected at random from the neutrally valenced words in Anderson (2005) and ANEW (Bradley & Lang, 1999). Sixty-five words were removed from the list as they were categorized as *other* by most participants. Given that the category *other* may have been too ambiguous, this contributed to a low category agreement between raters for certain words. The *other* category was removed from the next rating study and only categories of happy, angry, and neutral were used.

Two hundred and thirty first year undergraduate psychology students completed a separate online word rating survey. Participants were asked to categorize 195 words as either *happy, angry,* or, *neutral* emotions based on the category that best defined each word (See Appendix Table A2 for full word list). They were also asked to rate the emotional intensity of the same 195 words on a 9-point Likert scale ranging from *Extremely Weak* to *Extremely Intense.* Participants were given one hour participation credit for their time in completing the study. For each word, the word frequency, number of letters and orthographic neighbourhood sizes were obtained from the MRC Psycholinguistic Database (http://websites.psychology.uwa.edu.au/school/MRCDatabase/uwa_mrc.htm) and MC Word: An Orthographic Wordform Database (http://www.neuro.mcw.edu/mcword/). These were obtained prior to selection to facilitate matching of the word lists on word frequency, number of letters, and orthographic neighbourhood size across three emotion and distractor word lists. This procedure would ensure that the words will have similar ease of visual recognition (Lim, 2016; Tiffin-Richards & Schroeder, 2015) and attentional capture (Coltheart et al., 2004).

Word Rating Results

Following the selection of face stimuli, 10 target words from each emotional category (happy, angry, neutral), and 20 neutral distractor words were selected for use in Study 3. This equates the number of target and distractor words to target and distractor faces. The selected words had no less than 85% agreement amongst participants on category rating, which is comparable to the kappa values found for inter-rater reliability on the NimStim faces (Tottenham et al., 2009). According to McHugh, interrater agreement of 80% is a recommended minimum acceptable level, therefore the current study exceeds this level. The selected words were also chosen based on emotional intensity, number of letters, orthographic neighbourhood size, and word frequency, so that each emotional category would be comparable to each other, and that the neutral category would significantly differ on emotional intensity compared to the happy and angry categories.

One-way ANOVAs were run to compare the 10 target words from each emotional category and 20 neutral distractor words. These were item-based analyses, with emotion category (angry, happy, neutral target, and neutral distractor) as the independent variables and category agreement, emotional intensity, number of letters, orthographic neighbourhood size, and word frequency as the dependent variables. Refer to Table 4.2 for the means and standard deviations of categorisation agreement, intensity, number of letters, orthographic neighbourhood size, and word frequency. Results showed there were no significant differences between word lists for category agreement, $F(2, 29) = .54$, $p = .72$, $\eta^2 = .02$, number of letters, $F(3, 46) = .80$, $p = .51$, $\eta^2 = .05$, orthographic neighbourhood size, $F(3, 46) = .28$, $p = .84$, $\eta^2 = .02$, or word frequency, $F(3, 42) = .17$, $p = .91$, $\eta^2 = .01$. Note that word frequency data was transformed using $\log_{10}$ (word frequency + 1) to control for extreme skew in this variable, which is a conventional method used. There were also some missing values for word frequency. As expected, there was a significant difference between word lists for emotional intensity, $F(3, 46) = 734.71$, $p < .001$, $\eta^2 = .98$. Post-hoc comparisons revealed that target happy words were significantly higher in emotional intensity than target neutral and neutral distractor words (both *ps* < .001). Similarly, target angry words were also significantly higher in emotional intensity than target neutral and neutral distractor words (both *ps* < .001). As expected, target happy and target angry words did not differ in emotional intensity (*p* = .40). Refer to Table 4.3 for the final list of words that will be used in Study 3.

Table 4.2. *Means and standard deviations of category agreement and emotional intensity ratings for happy, angry, neutral, and distractor words.*

	Happy	Angry	Neutral	Neutral Distractor
Category Agreement (%)	96.18 (.85)	91.92 (1.38)	91.25 (2.26)	87.83 (.84)
Emotional intensity rating	6.63 (.40)	6.82 (.24)	3.68 (.08)	3.65 (.13)
Letters	6.10 (1.37)	6.10 (1.45)	5.80 (1.55)	5.45 (1.15)
Orthographic Neighbourhood	2.30 (4.60)	3.80 (6.00)	3.60 (3.60)	3.70 (3.51)
Word Frequency	1.21 (.68)	1.20 (.40)	1.29 (.59)	1.14 (.47)

Table 4.3. *Target and distractor word list*

Happy	Angry	Neutral	Neutral Distractors	
adore	violent	shawl	chart	minute
excited	hate	holder	grain	carpet

laugh	cruel	plaster	helmet	knee
love	hateful	square	carrier	flour
positive	argue	address	kidney	zipper
cheerful	outrage	pouch	supplier	crane
admire	annoyed	sum	oven	sign
enjoy	enraged	marginal	tail	border
awesome	irritate	swap	summary	clips
joyful	rage	tractor	jacket	coat

Discussion

In this study participants categorised words into emotion categories (happy, angry, neutral) and rated each word on emotional intensity. Words with a low category agreement or extremely high intensity rating were removed from the list. The remaining word lists were then compared on category agreement, emotional intensity, number of letters, orthographic neighbourhood size, and word frequency. The final word list consisted of 10 happy, 10 angry, 10 neutral and 20 neutral distractor words. These were matched on number of letters, orthographic neighbourhood size, and word frequency. Emotional intensity of happy and angry words was significantly higher in comparison to neutral target and neutral distractor words, which is ideal. The word list from this study adds to existing word lists (Anderson, 2005; Bradley & Lang, 1999; Clore et al., 1987) by providing further word ratings for specific emotion categories of happy, angry and neutral, as well as the emotional intensity of that word. In contrast to other attentional studies using emotional words based on valence ratings on a continuum of pleasantness to unpleasantness (e.g., Arend & Botella, 2002; Keil & Ihssen, 2004; Keil et al., 2006) or positive/negative valence (e.g., Mathewson et al., 2008; Shields & Murphy, 2011), the selected emotion words have been categorized as representative of a specific emotion (happy/angry/neutral). This may help to reduce ambiguity influenced by interpretation of words due to subjective experiences given that the word categorization has been confirmed to embody the happy, angry and neutral emotions by a sample of participants similar to those who will participate in Study 3. The selected words also provide emotional word stimuli that are similar to the emotional face stimuli that will be used in Study 3 as both sets are representative of the happy, angry and neutral emotions. In the following section and chapters of this thesis I will introduce and provide background information for Study 3.

CHAPTER 5: STUDY 3

MEDIA MULTITASKERS' PROCESSING OF EMOTIONAL STIMULI DURING VISUAL ATTENTION TASKS

The aim of Study 3 was to examine the processing of happy, angry and neutral emotional stimuli during visual attention tasks for heavy, average and light media multitaskers. As previous research suggests that media multitasking groups differ on various cognitive abilities, the third study was designed to help us to understand whether heavy media multitasking was related to differences on attentional task performance compared to average or light media multitasking. It will also provide insight on whether these groups have differences in attentional biases towards specific emotions. This is important because the current knowledge on the implications of media multitasking behaviour on emotion processing is limited, and this behaviour is rapidly increasing in society. No study to date has investigated the relationship between media multitasking and emotion processing using multiple attention tasks. In addition to media multitasking behaviour, Study 3 will also measure and control for trait and state anxiety and depression as previous literature has shown relationships between these and attentional task performance. The presentation of Study 3 will start with a brief introduction to the study, followed by information about participants and the general methodology. Each attentional task will then be presented as its own chapter (see Chapters 6 to 8), including a literature review, details about the task, results and discussion section.

Research in the current visual attention literature relating to emotion processing during attention tasks have generally only employed one task in the experiment (e.g., Byrne & Eysenck, 1995; Mogg et al., 2004; Vermeulen et al., 2009). Study 3 used three well-established attention tasks to measure different aspects of attention. The dot-probe task is known to measure selective attention (Macleod et al., 1986), the visual search task measures spatial attention (Treisman & Gelade, 1980), and the attentional blink task measures temporal attention (Raymond et al., 1992). The use of three well-established tasks with the same sample in Study 3 helps to close the gap between previous research across these tasks. This is because previous research using these visual attention tasks have had differences in samples and inclusion criteria even though the outcomes measured were similar. Some studies that have used the same attention task have also had differences in stimuli, task setup and task instructions, therefore making it challenging to compare the consistency of findings. In addition, both emotional faces and emotional words will be used in each of the tasks in the current research. This will also add to existing evidence from a currently segmented literature where visual attention experiments use either emotional faces or emotional words, but not both.

Most studies exploring emotion processing using attention tasks have focused on either a healthy (e.g., Srivastava & Srinivasan, 2010) or clinical sample (e.g., Fox et al., 2005), or a comparison between the two (e.g., Bradley et al., 1999; Roberts et al., 2009). Current media multitasking studies have focused on tasks that measure cognitive functions such as task-switching (e.g., Ophir et al., 2009), inhibition (e.g., Cardoso-Leite et al., 2016), working memory (e.g., Ralph & Smilek, 2017), or attention but not to emotion, specifically (e.g., Baumgartner et al., 2017). Most of these studies have found deficits in cognitive tasks for those who engage in more media multitasking, and only a few studies have found contrasting results showing enhanced performance on such cognitive tasks (e.g., Alzahabi & Becker, 2013). Few studies have examined media multitasking and attention (Brasel & Gips, 2011), and most of these have been on self-reported attention (Baumgartner et al., 2017; Ralph et al., 2013) rather than objective performance. While these studies may inform predictions on how media multitaskers might perform on attentional tasks, the way they process emotional information is still unknown since emotional stimuli were not used in those studies. Only one study has investigated emotion processing in media multitaskers using attentional tasks (a dot-probe task), showing that HMM were more focused on positive stimuli and more avoidant of negative stimuli compared to LMM (Shukla, 2016), and none have employed tasks assessing different types of attention. The current study fills this gap in the literature. Study 3 used the dot-probe task, visual search task, and attentional blink task to assess selective attention, spatial attention, and temporal attention to emotional face and emotional word stimuli. Performance on these tasks was compared between heavy media multitaskers (HMM), average media multitaskers (AMM), and light media multitaskers (LMM).

Previous research has found that heavy media multitasking is related to higher levels of anxiety and depression (Becker et al., 2013). Others have also found links between media multitasking and poorer psychosocial well-being (e.g., Pea et al., 2012; Reinecke et al., 2016; Xu et al., 2016). Given that this was a novel study, the rationale for expecting a relationship between media multitasking and emotion processing stems from the literature suggesting that media multitasking is related to mood and well-being (e.g., depression and anxiety scores), as well as performance on cognitive tasks. Previous studies show that levels of depression and anxiety affect emotion processing performance on attention tasks such as the dot-probe, visual search, and attentional blink. Therefore, it is hypothesised that media multitasking may be related to emotion processing on an attention task. Although more details on the hypotheses for each task will be presented in the relevant chapters, based on existing cognitive research and evidence on media multitaskers, it was generally expected that:

- On the dot-probe task, attention would move towards emotional stimuli compared to neutral stimuli in all groups. HMM would be more biased towards angry emotions, whereas AMM and LMM would be more biased towards happy emotions.

- On the visual search task, it is expected that participants would take a longer time to search for a target when the display has more items on it. HMM are expected be slower than AMM and LMM, especially when displays have more items on it. However, HMM are expected to be quicker at finding angry stimuli compared to AMM and LMM.
- On the attentional blink task, there should be greater impairment for identification of targets that follow an angry stimulus compared to when targets that follow a happy stimulus. It is expected that HMM would have more impaired identification of targets that follow an angry stimulus compared to AMM and LMM.

General Method Study 3

I refer to Study 3 as an "experiment" because while I acknowledge that there was not a direct manipulation of the between-subjects variable (i.e., media multitasking group was a quasi-experimental variable), there were a number of within-subjects variable manipulations across all three attention tasks that were done in a simultaneous sitting. In addition, the term "experiment" is used across the literature in this area to describe studies of a similar setup. Therefore, to describe Study 3 in a concise manner, the term "experiment" is used.

Participants

Two hundred and sixty five university students took part in an online survey that took around 30 minutes to complete. Those who consented to be contact were invited to take part in the second part of the study. Of those who consented to be contacted, 96 participants (62 females, 34 males) agreed to return for a two hour experiment at Griffith University Gold Coast Campus, completed individually in a computer laboratory. The mean age was 23.05

years (SD = 6.42 , min = 17, max = 50). Participants who were enrolled in first year psychology received 0.5 hour course credit for taking part in the online survey, and an additional 2 hours course credit for taking part in the experiment.

Materials for the online survey

Study 3 used the Media Multitasking Index (MMI), Maryland Trait State Depression – trait form (MTSD-T; Chiappelli et al., 2014), State-Trait Anxiety Inventory – trait form (STAI-T; Spielberger et al., 1983). These measures and their psychometric properties have already been described in Chapter 2. In addition, this study included the MTSD-state form (MTSD-S; Chiappelli et al., 2014) and STAI-state form (STAI-S; Spielberger et al., 1983).

Maryland Trait State Depression – State form (MTSD-S). The MTSD-S (Chiappelli et al., 2014) included 18-items assessing state depression. Participants were asked to rate themselves on how they have been feeling in the recent week on a 5-point Likert scale ranging from "not at all" to "5-7 days". Scores on each item are summed to obtain a total score. Higher scores indicated a higher level of state depression symptoms. Examples of items from the MTSD-S include:

- I have lost interest in enjoyable activities
- I sleep much more than usual because of my mood

State-Trait Anxiety Inventory – State form (STAI-S). The STAI-S (Spielberger et al., 1983) consists of 20 questions assessing state anxiety. Participants responded based on how they are feeling right now, and rate themselves on a 4-point Likert scale ranging from "not at all" to "very much so". Half the items were reversed scored, then the sum of all items formed the final score. Higher scores indicated a higher level of state anxiety symptoms. Example items from the STAI-S include:

- I am presently worrying over possible misfortunes

- I feel at ease (R)

Table 5.1 represents Cronbach's alphas for the trait and state anxiety and depression measures. All measures had a high level of internal consistency overall and within each group.

Table 5.1. *Internal consistency for measures overall and within groups*

	MTSD-T	MTSD-S	STAI-T	STAI-S
Cronbach's alpha (*N* = 96)	.93	.94	.93	.95
HMM	.94	.96	.95	.95
AMM	.92	.91	.89	.94
LMM	.91	.94	.92	.93

Maryland Trait-State Depression Trait/State form (MTSD-T/MTSD-S), State Trait Anxiety Inventory Trait/State form (STAI-T/STAI-S)

Three attentional tasks were used in this study: the dot-probe task, the visual search task, and the attentional blink task. All tasks were presented on a Dell OptiPlex 7040 Intel® Core™ i5-6500 2.30GHz desktop computer using a 64-bit Windows operating system and 21-inch monitor. Tasks were run on DMDX (Forster & Forster, 2003), where response times (RTs) in milliseconds (ms) and errors (%) on the dot-probe and visual search tasks were recorded by DMDX. Responses on the attentional blink task were manually scored. All face stimuli were resized to 98 x 128mm and presented in black and white on all tasks. Words were presented in black Arial font size 36.

Procedure

This study was conducted in two parts. First, participants completed an online survey consisting of the MMI, MSTD-T, and STAI-T. Participants who scored above 4.01 and below 2.38 on the MMI were categorized into heavy (HMM) and light media multitasking (LMM) groups, respectively. These cut-off scores were upper and lower quartiles obtained from the combined sample of those who completed the MMI in Study 1, and those who completed the MMI in the current study (*N* = 692). This was done to further ensure that the MMI scores were representative of the sample in this study. Those who scored between the cut-offs were categorized in the average media multitasking (AMM) group. The final groups consisted of 32 participants each (Refer to Table 5.2 for descriptive statistics). During the experimental session, participants completed the STAI-S and MTSD-S through an online computer survey, which took no more than 10 minutes. Participants then completed the three attentional tasks where task order was randomized. For each task, after the practice trials, participants were asked whether they understood the task and if they had any questions about the task. The presentation order of the face and word stimuli versions of the task was counterbalanced with consecutive versions of the same task completed one after the other before participants moved on to a different task. More details on each task will be provided in the following three chapters.

Results

Table 5.2 shows the gender distribution, mean age and mean MMI scores in each group. A one-way ANOVA determined that the groups differed significantly from each other on MMI scores, $F(2, 95) = 249.51$, $p < .001$. Bonferroni's post-hoc comparisons showed that HMM had significantly higher MMI score than AMM and LMM, and AMM had significantly higher score than LMM (all *ps* < .001). A one-way ANOVA determined that MMI groups did not differ significantly from each other on age, $F(2, 95) = .44$, $p = .65$. A Chi-Square test also indicated that MMI groups did not differ on gender, $\chi(2) = .64$, $p = .73$, with Phi indicating a weak strength of association between the variables (*φ = .08)*.

Table 5.2. *Descriptive statistics for the experimental groups*

Group	Females	Males	Mean Age (SD)	Mean MMI (SD)

HMM	20	12	22.97 (7.31)	4.96 (.76)
AMM	22	10	22.34 (5.22)	3.00 (.40)
LMM	20	12	23.84 (6.68)	1.77 (.52)

Results from a one-way ANOVA indicated that MMI groups differed significantly from each other on state anxiety, $F(2, 95) = 5.55$, $p = .01$. Bonferroni's post-hoc analyses showed that LMM scored significantly lower than AMM and HMM on state anxiety, $p = .04$ and .01 respectively. However, AMM and HMM did not significantly differ on state anxiety ($p > .05$). MMI groups did not differ significantly from each other on state depression, $F(2, 95) = .46$, $p = .63$, trait depression, $F(2, 95) = .59$, $p = .56$, or trait anxiety, $F(2, 95) = .40$, $p = .67$. Table 5.3 shows the means and standard deviations for each measure.

Table 5.3. *Means (SD) for each group on anxiety and depression measures.*

	State Depression	State Anxiety	Trait Depression	Trait Anxiety
Total (*N* = 96)	32.86 (12.26)	35.77 (11.54)	37.99 (13.02)	42.14 (10.50)
HMM (*N* = 32)	34.56 (13.91)	39.22 (13.07)	38.91 (14.12)	42.53 (11.51)
AMM (*N* = 32)	32.22 (10.66)	37.53 (11.13)	35.94 (13.23)	40.81 (10.42)
LMM (*N* = 32)	31.81 (12.20)	30.56 (8.34)	39.13 (11.76)	43.06 (9.69)

Correlations Between MMI and Mood Measures

Pearson's correlations analyses were conducted to examine the relationship between MMI and trait/state anxiety and depression for the current sample. Overall MMI score was significantly correlated with state anxiety, $p = .01$, but not significantly correlated with state/trait depression and trait anxiety (see Table 5.4). For HMM, MMI scores and state depression scores were positively related, $p = .03$.

Table 5.4. *Correlations between MMI and anxiety and depression measures*

	State Depression	State Anxiety	Trait Depression	Trait Anxiety
Total (*N* = 96)	.17	.28**	.06	.06
HMM (*N* = 32)	.39*	.04	.18	.26
AMM (*N* = 32)	.14	.05	.23	.22
LMM (*N* = 32)	-.02	-.01	-.06	-.02

*$p < .05$, **$p < .01$

Summary

This chapter provided an overview of Study 3, with a focus on presenting information relating to the measures used, and matching of media multitasking groups. Internal consistency was high for all measures. This was the case for the full sample and for each group. The groups were significantly different from each other on MMI scores and matched on age and gender. For Study 3, this would help to reduce age and gender differences, which have previously been found to have an effect on attentional task performance (e.g., Fairfield et al., 2016; Hahn et al., 2006). It was also important that groups differed on MMI scores so that group performance differences can be attributed to the independent variable (MMI score).

With the current sample, it was found that MMI was significantly related to state anxiety but not trait anxiety, trait depression or state depression. This differs from the results found in Study 1, where MMI was significantly related to both trait anxiety and depression (state anxiety and depression was not measured in Study 1). It may be that the relationships found in Study 1 were of a weak strength, therefore the smaller sample size in the current study was not sufficient to elicit a significant relationship. The results also differs from Becker et al. (2013) where state depression was found to be linked to media multitasking. However, Becker et al. (2013) also found that state anxiety was related to MMI score, which is consistent with the current results although they used a measure of social anxiety while

Study 3 measured general anxiety. In addition, visual attention studies have also demonstrated a link between state mood and attentional bias (e.g., Derakshan & Koster, 2010; Fox et al., 2005; Price et al., 2013). Given this, the analyses in Study 3 used state anxiety and state depression as covariates to exclude differences in performance attributable to differences in state mood.

The next chapter will focus on the dot-probe task used in Study 3. It will cover a literature review of relevant dot-probe studies including theories accounting for the findings, the methodology used in Study 3, results of the dot-probe task and a discussion section.

CHAPTER 6: DOT PROBE TASK

Overview of the Dot-Probe: Early and General Studies

The dot-probe task (Macleod, Mathews & Tata, 1986), also known as the visual-probe task, is a measure of selective attention. Typically, two stimuli (e.g., one emotional, one neutral) are presented at the same time in two spatial locations (e.g., left and right), followed by a probe (e.g., a dot) appearing in one of the stimulus positions for around 500-1000ms. Participants are required to react as soon as they have detected the probe. When the probe appears at the position of the emotional stimulus, faster reaction times compared to when the probe appears at the neutral stimulus indicates vigilance to that emotion. On the other hand, faster reaction times when the probe appears at the neutral stimulus relative to the emotional stimulus indicates avoidance of the emotion (Macleod et al., 1986). This chapter covers some general dot-probe studies, followed by cognitive theories accounting for differences in performance on the dot-probe, and then focuses on dot-probe studies using emotional stimuli as these will be most relevant to Study 3. Many of the dot-probe studies presented in this chapter are dot-probe experiments conducted with anxious and depressed individuals because this paradigm is commonly used in studying attention in these populations. Only one study has used the dot-probe task to examine emotion processing in media multitasking groups, therefore the use of other existing studies is necessary to provide background and a rationale for the current study.

The dot-probe paradigm was initially used by Macleod et al. (1986) to investigate attentional biases in clinically anxious people. The experiment presented emotionally threatening words paired with neutral words. Threat words could be related to physical threat (e.g., *injury*), or social threat (e.g., *criticized)*. On each trial, participants were required to read the word above the centre of the screen out loud, then press a hand-held button immediately when the dot was detected. The dot could appear at the position of either word. The benefit of having a neutral response (button pressing) to a neutral stimulus (dot probe) is that it eliminates bias in implementation of a response, and can therefore be used to examine the relationship between mood and emotional material encoding. Results from the study indicated that anxious individuals were more vigilant towards both types of threatening stimuli than the control group. In contrast, nonanxious controls had the tendency to avoid threatening stimuli (Macleod et al., 1986).

Early dot-probe studies.

The dot-probe paradigm has been used to examine attentional biases in depressed individuals compared to nondepressed individuals (Gotlib, McLachlan & Katz, 1988; Hill & Dutton, 1989). Gotlib et al. (1988) used three types of word pairs: manic-neutral, depressed-neutral, and manic-depressed[1]. Inconsistent with their hypothesis that depressed individuals would attend more to depressed-content words, the results showed that they attended to depressed, manic and neutral-content words equally. Furthermore, it was hypothesized that nondepressed individuals would not exhibit attentional biases. Instead, results showed that nondepressed individuals were more biased to manic-content words more than depressed and neutral words. Hill and Dutton (1989) studied sub-clinically depressed and nondepressed individuals' attentional biases to self-esteem threatening and non-threatening words. Although the depressed group showed generally slower reaction times, there was no specific bias indicating no vigilance towards threat words. Therefore this study suggests that depressed individuals do not show attentional biases towards negative stimuli such as depressed or threat words. However, it should also be noted that the participants were mildly depressed at a sub-clinical level. Hence, it may be that the severity of depression in these

---

[1] Where possible, sample stimuli from articles have been noted. However, where examples are not given, it is due to the unavailability of this information in the article.

samples was not strong enough to elicit attentional biases towards negative stimuli.

Mathews, Ridgeway and Williamson (1996) conducted a dot-probe experiment with clinically depressed and clinically anxious participants. Their results showed that depressed participants were vigilant towards socially threatening words, but anxious participants were not. Instead, anxious participants showed vigilance for physically threatening words. These results contradict other studies of clinically anxious participants (Macleod et al., 1986), but suggest the possibility that attentional biases occur in people with depression, though these biases are not strongly apparent in non-clinically depressed participants. Another explanation could be that negative cognitive biases in depressed people are maintained by ruminating. Hence, the presentation times were too short (i.e., 50ms) for rumination to occur. Findings from a study by Gotlib et al. (2004) highlight this possibility by showing that when stimuli were presented for 1000ms, clinically depressed participants directed their attention selectively to sad faces, but not to angry or happy faces. However, clinically anxious participants did not exhibit any similar bias at this longer presentation time. Study 3 will use both a short and long presentation time to ensure that the study is able to assess attentional biases that may develop across different time frames in media multitasking groups.

Personal relevance of stimuli used in a dot-probe task.

Perhaps the inconsistencies in results across studies noted above might be due to the personal relevance of stimuli, which serves as a crucial factor in determining an individual's attentional bias. For example, Dear et al. (2011) investigated the importance of stimulus-related factors such as personal relevance and ecological validity in pain-related attentional biases. Results showed that vigilance was found among both chronic pain patients and pain-free controls for idiosyncratically selected pictorial stimuli, but not for the word stimuli. This indicates that stimulus factors such as ecological validity and personal relevance are important for studies of attentional bias. Study 3 will use both emotional face and word stimuli. In addition, the word stimuli have been rated on the extent to which they represent the definition of each emotion, thus reducing subjective interpretation of word meanings and reducing attentional biases due to personal relevance.

Studies comparing populations with other conditions also adds to the evidence supporting a contribution of personal relevance for attentional bias. Ehrman et al. (2002) found that current smokers had greater selective attention towards smoking-related stimuli than nonsmokers. A subsequent study compared current smokers to former smokers and found that former smokers showed an intermediate level of bias that did not differ significantly from current and non-smokers. This suggests that personal relevance is not only related to the presence of an attentional bias towards certain stimuli, but also the magnitude of that bias. Lubman et al. (2000) found similar results with pictures associated with drug use in opiate addicts. Another study showed that heavy social drinkers showed greater attentional bias towards alcohol-related pictures than occasional social drinkers (Townshend & Duka, 2001). However, this effect was not evident in the alcohol-related words condition. Consistent with these results, Furhter et al. (2010) found that participants with anorexia were more biased towards self-photos as compared to a matched body photo, and that this was correlated with body dissatisfaction. Taken together, these studies support the influence of personal relevance on attentional biases.

Given that previous studies have found a relationship between media multitasking and cognitive processes, as well as between media multitasking and emotional traits and states, further research needs to explore whether there is a link between media multitasking and the processing of emotions on cognitive tasks. Study 3 will examine emotional processing in media multitaskers, hence the focus of the reviewed literature will be on the dot-probe paradigm using emotional stimuli. The next section will cover main cognitive theories accounting for selective attention to emotion as shown in the dot-probe task.

Relevant Theories of Selective Attention to Emotion

Early theories.

Beck (1976) proposed an early theory explaining attention to emotional stimuli as a set of negative dysfunctional schemata that influence and bias information processing. This then encourages a cycle of negative experiences for people with psychopathologies, and continues to maintain their condition. Bower (1981) put forward an associative-network model, which describes the spreading activation from emotion nodes. According to this model, memory is made up of an associative network of semantic concepts that are used to describe events. A basic process of thought is the activation of these concepts, which spreads from one node to another through associative links. Each emotion has a specific node, which is connected to various aspects of that emotion by associative links. For example, the emotion node of fear may be associated with autonomic reactions (e.g., increased heart rate) and expressive behaviours (e.g., crying). The emotion may also be linked with concepts describing events that have occurred in one's experiences that previously elicited this emotion. Activation of the emotion node occurs when a cue describing an event (or partially) is present, and sends feedback that excites the specific emotion node. Although both theories (Beck, 1976; Bower, 1981) remain influential, these models are too simplistic, and assume that all forms of information processing receive the same biases across all disorders. Since this uniformity has not been supported by evidence studying various clinical populations (e.g., Joormann & Gotlib, 2007; Mogg & Bradley, 2002) these models alone are insufficient to fully account for biases in attention towards emotional stimuli. Later theories have tried to include accounting for varying biases across different populations.

Two-stage theory.

The two-stage theory proposed by Williams et al. (1988) places importance on the direction of attention based on differential resources and distinguishes priming from elaboration. According to this model, priming is considered an early automatic activation of the internal representation of a stimulus, which temporarily enhances its accessibility. Elaboration is a later strategic process, which creates and strengthens interconnections between representations, consequently affecting processes such as retrieval. The differentiation between these two mechanisms provides a critical difference to the earlier models (e.g., Beck, 1976; Bower, 1981) in that this model can account for findings implicating different cognitive-processing biases in different emotional disorders. For example, the priming mechanism is often shown in dot probe studies of trait anxiety, where participants reveal attentional vigilance towards threatening information, especially when stimulus presentation times are short (e.g., Mogg, Philippot & Bradley, 2004). Trait anxiety primes the individual to perceive information in a threatening manner, and therefore even during a short presentation time, threatening stimuli can capture the attention of those with trait anxiety. In contrast, studies show that in depressed participants, attentional biases towards negative information emerge when the stimulus has been presented for a longer time (e.g., Gotlib et al., 2004). According to the two-stage theory (Williams et al., 1988), this is explained by the elaboration mechanism as the longer presentation time allows for more elaborative attention processing to occur. In this process, the direction of resources is allocated based on the presence and strength of interconnections between representations. For a depressed person, negative stimuli have strong connections (i.e., through mood states, negative thoughts, negative perception of experiences) therefore attention is more likely to be given to negative stimuli than to neutral stimuli.

In addition, two mechanisms are proposed within this model (Williams et al., 1997): the affective decision mechanism (ADM) and resource allocation mechanism (RAM). The

ADM assesses the valence of the stimuli, while the RAM determines the degree of resources allocated to the incoming stimuli. Transient states such as mood can influence the ADM. For example, a current state anxious person might evaluate the valence of a threatening stimulus more highly than if they were to be in their normal (nonanxious) state. Individual trait differences influence the RAM, leading to a predisposition for greater allocation of resources towards the processing of emotion-congruent material. Therefore, according to this theory, personality and severity of clinical condition could both be influencing factors to this more enduring penchant towards certain types of emotional stimuli.

Information-processing model.

Öhman (1993) described an information-processing model of attention that suggests incoming information is first analysed by feature detectors before being processed by a nonconscious significance evaluation system (SES). This SES evaluates information and then forwards it to a conscious perception system, which processes stimuli for meaning. However, stimuli with high intensity or biological preparedness may lead to feature detectors activating autonomic arousal without the need for further processing. For example, high intensity threatening stimuli may activate autonomic arousal in preparation for a fight or flight response without further processing of whether it is an actual threat. This would induce vigilance towards the emotional stimulus rather than a neutral stimulus. The SES responds to stimuli automatically and preattentively, without awareness or direct strategic control. For example, a person who is anxious about being shot would be more vigilant and automatically respond to loud noises, even if they are not gunshot sounds. In media multitasking groups, it is uncertain whether exposure to multiple media forms alter the nonconscious significance evaluation system to become more responsive to negative stimuli in a similar way to how anxious and depressed populations may be more responsive to threatening information.

Cognitive motivational analysis.

The cognitive motivational analysis model (Mogg & Bradley, 1998) was proposed to account for the effects of state and trait anxiety on the cognitive processing of threat. However, it can also apply to other emotion-congruent effects, such as depression. It may also be relevant if media multitasking groups process emotional information differently due to their frequent media activities that contribute to their emotional state. Becker et al. (2013) found this to be the case, where higher levels of media multitasking was related to higher levels of depression and social anxiety. This model has two cognitive structures. The valence evaluation system (VES) evaluates stimulus threat value then influences the second structure, the goal engagement system (GES). Usually, the GES operates in a default "safety mode", which favors positive stimuli over negative stimuli. However, when a high-intensity evaluation is given by the VES, the GES interrupts currents goals and devotes resources towards that stimulus. While the VES can be affected by various factors such as situational context or biological preparedness, its reactivity takes into account both trait and state anxiety. Consequently the VES is more sensitive in highly anxious individuals than in low-anxious individuals, resulting in higher perceived threat evaluation in highly anxious individuals. Therefore, this view suggests that it is the subjective evaluation of threat rather than how the attentional system responds to threat that results in different attentional biases in high and low anxious individuals. Emotional stimuli in general, would require more resources to evaluate and determine its threat level compared to neutral stimuli. Further, emotional stimuli should have a higher intensity than neutral stimuli. Taken together, it explains why emotional stimuli produce faster RTs than neutral stimuli on a dot-probe task, and would predict that HMM respond more quickly towards angry stimuli, but not happy stimuli, compared to AMM and LMM.

Emotion-specific biased competition model.

This model by Mathews and Mackintosh (1998) suggests that for selective attention effects to be apparent, stimuli have to be presented in a competitive situation (i.e., presenting two stimuli simultaneously, as in the dot probe task). The competition for attention presents an overload of information, which activates a threat-evaluation system (TES). The TES operates via two routes. The slower route operates when threat value is appraised by higher-level consciously controlled processes (e.g., watching the news on TV about a gang fight). This initial assessment of threat may involve processes such as generating internal images of dangerous events relating to it (e.g., of oneself being attacked by a gang). These processes find matching representations in the TES and elicit anxiety. Subsequent encounters with related cues (e.g., seeing a gang walking towards you) may also capture attention, and possibly elicit anxiety, via the quicker route. This occurs without further higher-level processing and elicits the emotion automatically. Input from the TES to a threat representation is strengthened as current anxiety level increases. Potentially threatening materials are generally tagged and increase automatic selective attention, so this gives the threatening stimulus a greater advantage than a non-threatening stimulus in the competition for resources, hence eliciting significant attentional biases as compared to their control counterparts. As emotional stimuli have more potential for threat than neutral stimuli, emotional stimuli are expected to produce faster RTs than neutral stimuli.

A key consideration of this model is the accounting for possible top-down effects on emotional processing. This top-down effect refers to cognitive control and the ability to alter or stop a process once it has started. This is done by a “task demand” component that can enhance the activation of any item within the competition. This task demand refers to a voluntary effort, which can (up to a point) counter interference caused by anxiety levels to the TES. According to this model, all stimuli, including both emotional and nonemotional items, have separate representations that the task demand component can influence based on task instructions or contextual conditions. For example, a person might be anxious about giving a speech. However, adding task instructions and contextual conditions such as telling the person that the speech would be filmed and assessed by a panel of experts, may heighten that anxiety and therefore influence the representation of an item (e.g., a facial expression displayed). This can also produce differences in RTs between emotional and neutral stimuli. Since this model emphasizes the evaluation of incoming stimuli, it is assumed that the influence of task demands leads to an increase in automatic selective attention for task relevant stimuli and can also increase dismissal of task irrelevant stimuli to some extent. The task demand does this by providing further activation to the target representation, thus reducing the distraction effect.

Summary of dot-probe theories

According to the two-stage theory, attention is directed based on differential resources and uses two mechanisms to assess stimuli valence and allocation of resources (Williams et al., 1988; Williams et al., 1997). Öhman (1993) proposed an information-processing model that featurally processes incoming information, is evaluated unconsciously, then forwarded to a conscious processing system. The cognitive motivational analysis model describes information processing and valence evaluation to be influenced by emotion-congruence and emotional states (Mogg & Bradley, 1998). Another model proposed by Mathews and Mackintosh (1998) suggests that selective attention effects occur when stimuli compete for attention using a threat evaluation system, and are influenced by task demand and cognitive control. Hence, any of these models have the potential to explain differences in the processing of neutral and emotional information that could occur through these mechanisms for different media multitasking groups. The next section will review various dot-probe studies examining selective attention to emotional face stimuli. These studies are relevant because Study 3 used emotional face stimuli in a dot-probe task.

Dot-probe and Emotional Faces

Many dot-probe studies have examined how people allocate attention and process emotional faces. The evidence consistently shows that emotional faces capture attention more than neutral faces (e.g., Alpers & Gerdes, 2007; Fox, 2002; Mogg & Bradley, 2002). This outcome is consistent with the emotionality hypothesis (Martin, William & Clark, 1991), which predicts cognitive biases for all emotional faces relative to matched neutral faces. However, there is uncertainty over whether there are biases towards specific facial expressions. For example, Alpers and Gerdes (2007) used angry, fearful, surprised, and happy faces in their experiment and found that emotional faces were perceived more quickly and for longer durations as compared to neutral faces. The authors expanded their results by using schematic faces (positive, neutral and negative) in a later experiment. Results were consistent with the first experiment in that there was more attentional vigilance towards positive and negative faces compared to neutral faces. This study provides a good example of a study using both real and schematic faces, and a range of emotions with a non-clinical sample. However, as shown in the studies presented in Table 6.1, there is still some ambiguity over whether the biases are only towards specific emotional faces, and whether this differs across various populations.

Table 6.1 summarises studies in the literature using a dot-probe task and emotional face stimuli. This provides an easy way to make comparisons between methods and stimuli used across studies, and the main findings of each study. As detailed in Table 6.1, anxious participants appear to have attentional biases towards threatening faces compared to low anxious or control groups (Bradley et al., 1999; Bradley et al., 2002; Heim-Dreger et al., 2006; Mansell et al., 1999; Pishyar et al., 2004; Price et al., 2014). This is generally consistent across studies, however some studies have shown that this is dependent on the presentation times of the face stimuli in a dot-probe task (Mogg et al., 2004). At shorter presentation times, attentional biases were observed, but at slower presentations times there were no biases found. This is likely due to the vigilance towards threatening information in anxious individuals that drive them to quickly identify and assume threat, however, longer presentation times allow more time for that information to be processed. During this additional time, the individual has more time to rationalise the threat or use other coping strategies to minimise the threat. This would then allow both emotional and neutral stimuli to be processed and evaluated, therefore reducing attentional bias towards emotional stimuli. With happy faces, there have been more inconsistencies across previous studies. Some studies have found that in anxious participants, there were no biases towards happy faces (Bradley et al., 2000), while others found that anxious participants avoid happy faces (Fox, 2002). One explanation for this could be that anxious participants are more attuned and generally seek out negative information, that positive information is avoided or ignored because it does not concur with what the individual is attuned towards or looking for.

As described in Table 6.1, other studies have found socially anxious participants avoid emotional faces, which is consistent with the symptoms of social anxiety, but demonstrates differences in attentional bias between socially anxious and generally anxious participants (Chen et al., 2002). Mansell et al. (1999) found results consistent with this but only under social-evaluative threat. This shows that situational threat and state mood can also influence attention allocation. Another study showed that high socially anxious participants were more vigilant to negative faces, which is more similar to the evidence for generally anxious participants (Pishyar et al., 2004). On the other hand, participants with social phobia have also been shown to have no difference in attentional bias compared to healthy controls in a range of emotional categories (Gotlib et al., 2004). Results from these studies continue to demonstrate inconsistent findings across studies, particularly since varying levels and type of anxiety is present.

Since media multitaskers have been suggested to use a breadth-base cognitive processing style (Ophir et al., 2009) and found to have poor filtering abilities (Cardoso-Leite et al., 2016; Ophir et al., 2009), it is likely that HMM would also attend to stimuli and quickly assume threat, particularly in angry faces, compared to AMM and LMM. However, at a longer presentation time, HMM may tend to disengage (Ralph & Smilek, 2017) and become more easily distracted by other stimuli, so they would respond more slowly to emotional stimuli compared to the shorter presentation time and compared to the other two groups. It is likely that HMM would still respond more quickly to happy faces compared to neutral faces as emotional stimuli capture attention better, but they may be slower than AMM and LMM in doing so due to poor filtering and distractibility. In Study 3, both trait and state mood measures were used to identify any media multitasking group differences and control for mood if necessary.

Participants with depression showed more vigilance towards negative emotional faces (Joorman & Gotlib, 2007; Joorman et al., 2007) and more avoidance of positive emotional faces (Gotlib et al., 2004). Attentional biases towards negative faces in depression is predicted by trait-like characteristics, as the bias was seen in current and formerly depressed patients (Joorman & Gotlib, 2007), as well as girls at risk of developing depression (Joorman et al., 2007; Kujawa, 2011). These results were partially supported by Bistricky et al. (2016) who showed links between attention to sad faces during a dot-probe task and negative feedback-seeking, depressive symptoms, and interpersonal competence. They also showed that attention to happy faces correlated negatively with rumination. Taken together, the research suggests that people with depression frequently attend to negative stimuli which can develop and maintain depressive mood, and thus these attentional biases.

Following the emotionality hypothesis (Martin, William & Clark, 1991), and given that the rapid attentional capture of threatening information is adaptive to survival, media multitaskers are constantly exposing themselves to negative stimuli through multiple media forms and naturally attending to them even when positive emotional stimuli are also present. Over time, they may become more efficient and attuned towards negative information, hence HMM would show more attentional bias towards negative (i.e., angry) faces compared to AMM and LMM. While it could be argued that HMM could be exposing themselves to lots of positive stimuli instead, this is unlikely given that media studies suggest that consumers prioritise negative versus positive information (Trussler & Soroka, 2014). Therefore, this increases responsiveness, audience numbers and sales of published negative information and encourages more publication of negative information (Trussler & Soroka, 2014) and further increases media multitaskers' exposure to negative information.

Dot-probe study with media multitaskers.

A recent study by Shukla (2016) compared high and low media multitaskers using a dot-probe experiment with facial emotional stimuli. Emotional faces were categorized as high and low intensity of positive and negative images, and neutral faces of the same actor. Twenty emotion-neutral face pairs were selected. Each trial presented a face pair for 1000ms on the left and right side of the screen. A dot then appeared in one of the face locations until participants responded by deciding which location the dot was at. The study found that HMM showed attentional bias towards positive faces when paired with a neutral face. No biases towards neutral or positive faces were observed in the LMM group. For negative-neutral face pairs, LMM were biased towards negative faces, while HMM were more biased towards neutral faces. This indicates a tendency to focus on positive stimuli and avoidance of negative stimuli in HMM, while LMM were more vigilant to negative stimuli. The results partially support the notion that emotional faces capture attention more readily that neutral faces (Shukla, 2016). It also highlights the question of whether media multitasking behaviours alter the way emotional information is processed, or preferences for attending to certain types of emotional information.

Currently, Shukla (2016) is the only published dot-probe study using emotional face stimuli comparing media multitaskers, which presents an opportunity for Study 3 to expand on the available research on media multitaskers' performance on emotional attention tasks. Although Shukla's (2016) findings conflict with the predictions of the current research, Study 3 draws these hypotheses from the existing literature on the relationship between media multitasking and well-being (e.g., mood) as well as media multitasking and cognitive performance. The hypotheses are also based on existing research on the dot-probe task, which generally indicates greater bias towards threatening information, particularly in populations with higher mood disorder symptoms compared to a general population. The next section will summarise research that has been done using emotional words on a dot-probe task.

Table 6.1. *Overview of dot-probe studies using emotional face stimuli.*

Author & Year	Sample type	Facial expression of stimuli	Procedure	Main findings
Fox (2002)	High and low trait anxious	Fearful, happy, neutral	Experiment 1: 500ms face pair (left/right) Probe (either . . or :) Participants indicated which type of probe appeared	High trait anxious participants vigilant towards fearful faces, but avoidant of happy faces Low trait anxiety participants did not show emotion processing asymmetry.
Mogg & Bradley (2002)	High and low socially anxious	Threat, happy, neutral	17ms face pair, followed by jumbled face pair masks	High socially anxious participants responded faster to threat faces than low socially anxious participants No biases for happy faces in both groups
Bradley et al. (1999)	Patients with GAD and healthy controls	Angry, happy, neutral	Face pairs presented for either 500ms or 1250ms	GAD patients biased towards angry faces and more vigilant towards emotional faces in general, compared to control participants. Vigilance for happy faces only appeared in second half of the task. Bias towards threat faces diminished slightly in second half of the task.
Mogg et al. (2004)	Participants with social phobia and healthy controls	Angry, happy, neutral	Face pair presented for either 500ms or 1250ms Up/down arrow probe	No bias for angry or happy faces in healthy controls Social phobia participants biased towards angry faces compared to happy and neutral faces, but only in 500ms condition. No significant biases in 1250ms condition
Pishyar, Harris & Menzies (2004)	High and low socially anxious	Positive (happy), negative (disgusted/judgmental), neutral	500ms face pair (top/bottom)	High socially anxious participants more vigilant towards negative faces Low socially anxious participants more vigilant towards positive faces
Bradley, Mogg & Millar (2000)	Low, medium and high state anxiety	Happy, sad, threatening, neutral	500ms face pair (left/right)	Enhanced vigilance towards threat faces for participants with high and medium state anxiety No biases for happy faces in any group. Association between high dysphoria scores and avoidance of happy faces.
Price et al. (2014)	Youths with GAD, separation anxiety disorder, social phobia	Fear, neutral	fMRI observation	Nonanxious participants able to deactivate responses to fearful faces when asked to direct attention away from threat. Anxious participants showed abnormal disengagement from threat

Heim-Dreger et al. (2006)	School aged pupils (mean age 9)	Friendly, threatening	1000ms face pair (top/bottom)	Positive correlation between vigilance towards threatening stimuli and state anxiety
Chen et al. (2002)	Patients with social phobia, healthy controls	Positive (happy), negative (angry, sad, fear, disgust)	Faces paired with neutral photographs of household objects 500ms picture pair (diagonally across)	Social phobia patients avoided all emotional stimuli. Healthy controls showed no attentional preference
Mansell et al. (1999)	High and low socially anxious	Positive (happy), negative (angry, disgust, fear, sad)	Faces paired with neutral photographs of household objects 500ms picture pair (diagonally across) Social-evaluative threat induced	High socially anxious participants avoided emotional faces, but only under conditions of social-evaluative threat. In the absence of social-evaluative threat, no differences in attention to emotional faces between high and low socially anxious groups.
Khatibi et al. (2009)	Chronic pain patients, healthy controls	Happy, pain, neutral	300ms face pairs (left/right)	Both groups avoided happy faces and attended to neutral faces. Chronic pain patients more vigilant towards pain faces than neutral faces. Control participants avoided pain faces
Mogg, Millar & Bradley (2000)	Depressed patients, most with comorbid GAD	Sad, neutral	1000ms face pair	No attentional bias for sad faces
Gotlib et al. (2004)	Patients with MDD only, social phobia, healthy controls	Sad, angry, happy, neutral	1000ms face pair	MDD patients biased towards sad faces compared to happy or angry faces. No difference between happy and angry faces in MDD patients. Greater MDD symptom severity associated with more avoidance of happy faces Social phobia participants showed no difference to other groups in any emotion category.
Joorman & Gotlib (2007)	Currently and formerly depressed patients, healthy controls	Happy, sad, neutral	1000ms face pair (left/right)	Current and formerly depressed groups biased towards sad faces. No bias towards happy faces. Healthy controls avoided sad faces, oriented towards happy faces.

Joorman, Talbot & Gotlib (2007)	Girls aged 9-14 with no diagnosed Axis-I disorder, with mothers with (at-risk group) or without (control group) history of MDD	Happy, sad, neutral	1500ms face pair (left/right)	At-risk group were biased towards negative faces, but no bias towards positive faces. Opposite results for control group. Control group still showed bias towards positive faces when negative mood was induced.
Kujawa et al. (2011)	5-7 year old children of depressed and non-depressed mothers	Happy, sad, neutral	1500ms face pair (left/right)	Children of depressed mothers showed bias towards negative faces, but only in daughters. Children of non-depressed mothers showed no bias towards negative faces. No significant effects for happy faces
Tran et al. (2013)	Subclinical anxious men and women	Happy, angry, fear, disgust, sad, neutral	50ms face pair	Highly anxious women were biased towards angry faces Highly anxious men were biased towards happy faces
Mather & Carstensen (2003)	Older (62-94 years) and younger (18-35 years)	Happy, sad, angry, neutral	1000ms face pair (left/right)	Older participants responded faster to neutral faces compared to sad or angry faces. They also remembered happy faces better than negative faces. No significant effect seen in younger participants

Dot-probe and Emotional Words

Unlike faces, words do not have universally recognizable features but are interpreted based on understanding, subjective meaning, and can differ across languages. As mentioned earlier, the first dot-probe study by Macleod et al. (1986) used emotional word stimuli to identify attentional biases in emotional disorders such as clinical anxiety. Since then, more research has been done using emotional word stimuli, and there have been some inconsistencies in results. This section will review dot-probe studies using word stimuli and various clinical and nonclinical populations. This will help to draw similarities and comparisons to dot-probe studies using face stimuli, because Study 3 compared heavy, average, and light media multitaskers on a dot-probe task using both emotional face and word stimuli.

Table 6.2 provides a summary of the relevant studies in this area to date. In summary, emotional words seem to capture attention more readily than neutral words. For example, in dot-probe tasks, healthy participants detected emotional words (especially negative) more efficiently than neutral words (Sutton & Altarriba, 2011) and anxious people show attentional biases towards threatening stimuli (Asmundson & Stein, 1994; Roberts et al., 2009). This was also shown in children and adolescents (Dalgleish et al., 2001). This could suggest that while it is natural for people to detect emotional words more easily than neutral words, constant attunement to negative words (as would be seen in anxious people) can further increase the attentional bias towards these types of words. Media multitaskers are constantly exposed to lots of emotional, and potentially negative, information through various media forms. For example, news articles, instant messaging, or social media status updates. This may lead to an increase in attention towards negative information in particular, as they have become more efficient at taking in information from multiple sources through unintentional practice. In addition, their poor filtering abilities (Ophir et al., 2009) inhibits the filtering of unwanted negative information, which in turn leads to more or longer exposure to negative stimuli. Therefore, it would be expected that HMM are more attentionally biased towards angry words on a dot-probe task compared to AMM or LMM. Since emotional stimuli capture attention more readily than neutral stimuli in most people, it is still expected that happy words would capture attention better than neutral words. However, since HMM might be more easily distracted if the stimuli does not immediately and strongly capture their attention, they may show slower response times towards happy faces compared to AMM or LMM.

As outlined in Table 6.2, studies have also shown that anxious people avoid threatening words (e.g., Mogg et al., 2000; Vassilopoulous, 2005; Yu et al., 2014). Socially anxious participants tend to be biased towards social-threat words but not other types of threat words (Roberts et al., 2009), and avoid positive social words (Yu et al., 2014). Some studies have also showed no biases towards threatening words in socially anxious people (e.g., Mansell et al., 2002). These differences may be explained by differences in stimulus presentation times, or participant mood states. Similar to those with other clinical conditions, Bradley et al., (1997) found that those with dysphoria had attentional biases towards negative words in the longer presentation time but not the shorter presentation time. Williams et al. (2014) also found that worriers who worried in a verbal manner were biased towards threat words. These results support the notion that depression-related biases may not occur in early automatic aspects of attentional processing, but with longer exposure times biases occur when more elaborate information processing has taken place. They also demonstrate that exposure to negative words (either physically or mentally) can increase attunement to them. For media multitaskers, the increase in exposure to negative words through multiple sources may also increase their attunement towards them, and hence they would selectively attend to negative words more than positive or neutral words, and compared to AMM or LMM.

Table 6.2. *Overview of dot-probe studies using emotional word stimuli.*

Author & Year	Sample type	Word type	Procedure	Main findings
Sutton & Altarriba (2011)	Healthy participants	Negative, positive, neutral	180ms word pair (left/right)	Participants responded faster to emotional words than neutral words, especially for negative words
Salemink, van den Hout & Kindt (2007)	Healthy participants	Threat, neutral	500ms word pair	Trait anxiety related to disengagement difficulties, but not to speed of orienting
Mogg et al. (2000)	Low anxiety, repressor, high anxiety groups	Physical threat, social threat, neutral household-related	500ms word pair (top/bottom)	General tendency across groups to avoid social threat words relative to neutral words, but only significant for repressor group (low trait anxiety, high social desirability). No biases for physical threat words across groups
Asmundson & Stein (1994)	GAD patients, healthy controls	Social threat, physical threat, neutral	500ms word pair (top/bottom)	GAD patients were faster than controls at detecting social-threat words.
Yu et al. (2014)	High and low socially anxious	Positive social, neutral	Word pair (top/bottom) for either 100ms, 500ms or 1250ms	In 100ms condition, low socially anxious group biased towards positive social words while high socially anxious group avoided. Similar trend seen at 500ms. No biases observed in either group at 1250ms.
Vassiolopoulos (2005)	Non-clinical socially anxious, low socially anxious	Social threat, positive social, physical threat, neutral	Word pair (left/right) for either 200ms or 500ms	Socially anxious group biased towards social threat words at 200ms, but avoided social threat words at 500ms.
Mansell et al. (2002)	High and low socially anxious	Neutral, positive, negative social evaluative	500ms word pair (diagonally across) Social evaluative threat induced for some	High socially anxious participants showed no significant biases towards or away from social evaluative words Participants in threat condition showed less avoidance of social evaluative words than those in nonthreat condition High trait anxiety associated with increased attention to negative compared to positive social evaluative words
Dalgleish et al. (2001)	Children and adolescents with PTSD, healthy	Physical threat, social threat, depression-related, neutral	1500ms word pair	Relative to neutral words, those with PTSD were biased towards social threat words but not physical threat words Relative to healthy controls, those with PTSD avoided

	controls			depression-related words.
Neshat-Doost et al. (2000)	Clinically depressed children and adolescents, healthy controls	Physical threat, social threat, depression-related, neutral	1500ms word pairs (top/bottom)	No biases towards any emotional word types.
Bradley, Mogg & Lee (1997)	Induced dysphoria, naturally occurring dysphoria	Depression-related, anxiety-related, neutral	Word pair (top/bottom) for either 14ms, 500ms, or 1000ms	Induced dysphoria associated with bias towards depression-related words in 500ms condition. Similar trend in 1000ms condition. Naturally occurring dysphoria related to bias for negative words in 1000ms. No bias shown in both groups for 14ms condition
Williams, Mathews & Hirsch (2014)	Worriers	6 domains of threat (relationships, lack of confidence, aimless future, work incompetence, financial, socio-political, physical, social), neutral	200ms word pair (top/bottom)	High worriers who worried in verbal manner biased towards threat words. High worriers who worried by imagery did not. Results could not be accounted for by personal relevance, trait anxiety or tendency to worry.

Summary of Relevant Dot-Probe Studies

In Chapter 6, relevant theories accounting for the dot-probe task were outlined. Existing studies using the dot-probe task were reviewed, with a particular focus on those that have used emotional face or emotional word stimuli. This is because Study 3 used emotional face and emotional word stimuli to compare attentional biases between media multitaskers.

Currently, the majority of studies have shown that emotional stimuli capture attention better than neutral stimuli (e.g., Alpers & Gerdes, 2007; Sutton & Altarriba, 2011), and that personal relevance to stimuli further boosts attention capture (Dear et al., 2011). With anxious participants the evidence has been inconsistent in that some studies show attentional biases towards threat (e.g., Mogg et al., 2004) while others indicate an avoidance of threatening stimuli (Vassilopoulous, 2005). The results have also been inconsistent among participants with depression. Some studies found attentional biases towards sad or threat faces (Gotlib et al., 2004; Joorman & Gotlib, 2007) and depression-related words (Bradley, Mogg and Lee, 1997), while others found no differences between depressed and control groups (Gotlib, McLachlan & Katz, 1988; Hill & Dutton, 1989; Neshat-Doost et al., 2000). These differences have been attributed to the presentation times of stimuli as well as varying criteria for clinical populations. Although Study 3 does not include a clinical sample, these previous studies give insight into how underlying biases that are consistent with a condition can then lead to attentional biases on a dot-probe task. They also provide a rationale for measuring both trait and state anxiety and depression in Study 3.

Only one dot-probe study has been conducted so far with a sample of media multitaskers, however only face stimuli were used with a single presentation time (Shukla, 2016). Study 3 examined a sample of media multitaskers to examine attentional biases for emotional faces and words. Both a short and long presentation time was used to confirm whether stimuli presentation time influences performance on the dot-probe task. It was expected that there would be a bias towards emotional stimuli compared to neutral stimuli in all groups. HMM would be more vigilant towards angry emotions and avoidant of happy emotions, compared to AMM and LMM, who would be more biased towards happy emotions.

Method

Participants

The participant characteristics and relevant media multitasking groupings were described in Chapter 5.

The dot-probe task

The dot-probe task consisted of a version that used face stimuli and another version that used word stimuli (as outlined in Chapter 4). There were two stimulus presentation times (500ms or 1000ms) for each version. Each target emotion face or word (happy/angry/neutral) was paired with a neutral face or word from the distractor stimulus pool (listed in Chapter 4). A target was never paired with another target. For each version, there were six target-distractor conditions (Phappy-neutral, happy-Pneutral, Pangry-neutral, angry-Pneutral, Pneutral-neutral, and neutral-Pneutral) and each condition had 20 trials at each presentation time. The 'P' refers to the position that the dot-probe appeared in. Each emotion appeared in the top and bottom position an equal number of times, separated on the vertical axis by a distance of 3cm. Each task had 12 practice trials and 120 experimental trials split into three blocks, for each presentation time. This totals to 240 experimental face trials and 240 experimental word trials.

Participants sat approximately 60cm away from the screen when completing the task. Trials began with a 500ms fixation cross, followed by two faces (or two words) one each in the top and bottom positions of the screen for either 500ms or 1000ms. This was followed by a black dot (the probe stimulus) in either the top or bottom position for up to 5000ms or until participants responded. The black dot appeared equally across locations and conditions. For each condition, there were equal numbers of trials with targets appearing at each position. The task was for participants to indicate the position of the dot by pressing Shift keys (right: top position, left: bottom position). Participants were asked to respond as quickly and accurately as possible. See Figure 6.1 and 6.2 for sample trials for the dot-probe face and word task, respectively.

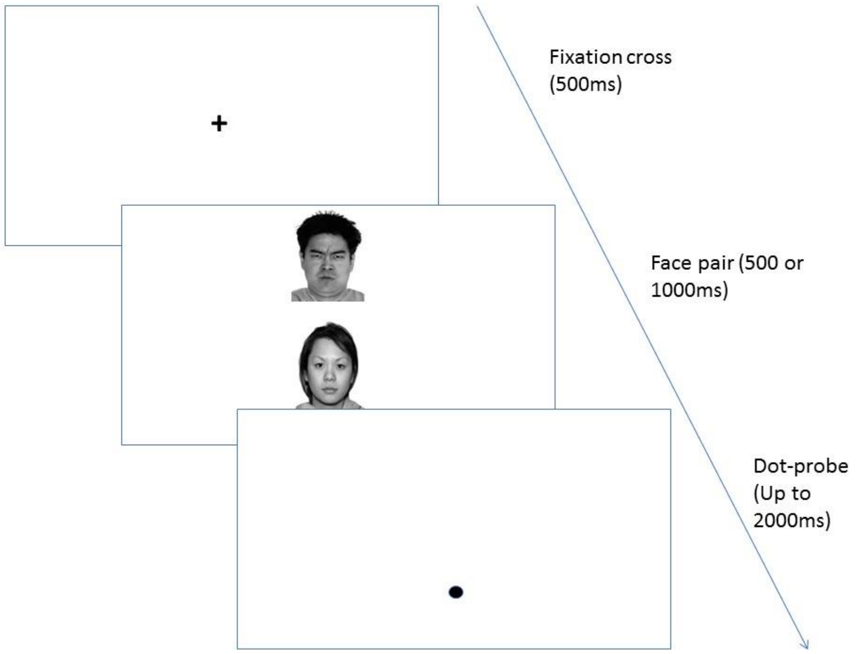


Figure 6.1. Example of a dot-probe face trial (angry-Pneutral).

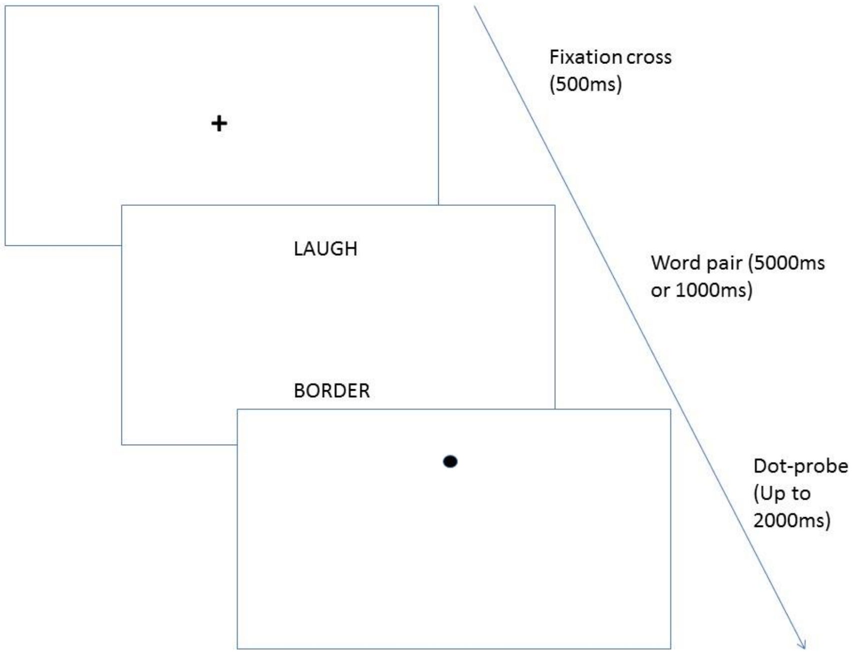


Figure 6.2. Example of a dot-probe word trial (Phappy-neutral).

Results

For each task, a mixed factorial ANCOVA was conducted using state depression and state anxiety as covariates, given that previous literature shows state mood to be related to attentional bias to emotions (e.g., Bradley et al., 1997; Mogg et al., 2004). The between-subjects IV was MMI group (three levels; HMM, AMM, and LMM). The within-subjects IV were conditions (six levels; Phappy-neutral, happy-Pneutral, Pangry-neutral, angry-Pneutral, Pneutral-neutral, and neutral-Pneutral) and presentation times (two levels; 500ms and 1000ms). The 'P' refers to the position of the stimulus that the dot-probe appeared in. Faster reaction times to the Phappy-neutral and Pangry-neutral conditions compared to Pneutral-neutral or neutral-Pneutral conditions would indicate bias towards the happy and angry emotion, respectively. Faster reaction times to the happy-Pneutral and angry-Pneutral compared to Pneutral-neutral or neutral-Pneutral conditions would indicate avoidance of the happy and angry emotions, respectively. The DV was RT (ms). A power of 0.56 was obtained using G*Power (Faul et al., 2007), to detect a medium effect size (f = 0.25). A power of 0.94

was obtained to detect a large effect size (*f* = 0.40). The levels of effect sizes are in accordance with Cohen (1977, 1988).

I ran the same analyses using trait depression and trait anxiety as covariates instead, as well as without any covariates (refer to Appendix B). It should be noted that where anxiety and depression was not controlled, there was a significant difference between presentation times (see Appendix B), whereby participants overall had slower RTs at the longer presentation time (1000ms). Otherwise, the pattern of results was similar, therefore only the results using state depression and state anxiety as covariates will be reported here as the literature suggests that these variables are most relevant to attentional task performance that would need to be controlled in this type of task (e.g., Bradley et al., 1997; Mogg et al., 2004). The dot-probe face task results will be presented first, including RT for correct responses and error rates, followed by the dot-probe word task, also including mean RT and error rates.

Dot-probe Face Task

Reaction time (RT)

Table 6.3 shows the mean RT for each group in each condition on the dot-probe face task. There were no significant differences in performance between groups, $F(2, 91) = 2.20$, $p = .12$, partial $\eta^2 = .05$, or between conditions, $F(5, 455) = .60$, $p = .70$, partial $\eta^2 = .01$. Results showed no main effect for presentation time, $F(1, 91) = 1.13$, $p = .29$, partial $\eta^2 = .01$.

There was a trend towards significance for the interaction between condition and group, $F(10, 455) = 1.80$, $p = .06$, partial $\eta^2 = .04$. The means and standard errors for this interaction are shown in Table 6.4. Further analyses showed no significant differences between the groups on all conditions (all *p*s > .05). For the HMM group only, participants responded significantly more slowly on the happy-Pneutral compared to the neutral-Pneutral condition (*p* = .02). All other condition differences within the HMM group and within the AMM and LMM groups were not significant (all *p*s > .05).

There was no interaction effect between group and presentation time, $F(2, 91) = .06$, $p = .94$, partial $\eta^2 = .001$, or condition and presentation time, $F(5, 444) = .75$, $p = .59$, partial $\eta^2 = .01$. The three-way interaction between condition, presentation time, and group was also not significant, $F(10, 444) = 1.14$, $p = .33$, partial $\eta^2 = .02$.

Table 6.3. *Mean RT and standard deviation for each group on different dot-probe face task conditions (adjusted for the covariates)*

Group	500ms PHappy Neutral	500ms Happy Pneutral	500ms PAngry Neutral	500ms Angry Pneutral	500ms PNeutral Neutral	500ms Neutral Pneutral	1000ms PHappy Neutral	1000ms Happy Pneutral	1000ms PAngry Neutral	1000ms Angry Pneutral	1000ms PNeutral Neutral	1000ms Neutral Pneutral
HMM	437 (94)	450 (96)	440 (94)	440 (85)	445 (101)	435 (88)	478 (97)	474 (91)	456 (81)	462 (87)	473 (82)	465 (80)
AMM	401 (81)	402 (73)	405 (75)	411 (91)	408 (89)	409 (84)	442 (94)	432 (79)	440 (91)	437 (86)	441 (92)	437 (76)
LMM	399 (87)	404 (85)	400 (86)	400 (90)	399 (81)	398 (85)	427 (88)	432 (75)	435 (87)	434 (88)	431 (74)	425 (74)

Table 6.4. *Mean RT and standard error for interaction between condition and group (adjusted for the covariates)*

Group	PHappy Neutral	Happy Pneutral	PAngry Neutral	Angry Pneutral	PNeutral Neutral	Neutral Pneutral
HMM	457 (15)	462 (14)	448 (14)	451 (15)	459 (14)	450 (13)
AMM	421 (15)	417 (14)	423 (14)	424 (14)	425 (14)	423 (13)
LMM	413 (15)	418 (14)	418 (14)	417 (15)	415 (15)	411 (14)

Error rates

Error rates in performance on the dot-probe task were also examined and showed that the error rates were generally quite low. HMM, AMM, and LMM did not differ from each other in overall error rates, $F(2, 91) = .48$, $p = .62$, partial $\eta^2 = .01$ (see Table 6.5). There was no significant difference in error rates for the two presentation times, $F(1, 91) = .28$, $p = .60$, partial $\eta^2 = .003$. The effect of condition was not significant, $F(5, 455) = 2.07$, $p = .07$, partial $\eta^2 = .02$. The interaction of condition and group approached significance, $F(10, 455) = 1.82$, $p = .06$, partial $\eta^2 = .04$. The relevant means and standard errors are shown in Table 6.6. Further analyses indicated no significant differences between conditions for all groups.

There was no significant interaction between group and presentation time, $F(2, 91) = .30$, $p = .74$, partial $\eta^2 = .01$, or between condition and presentation time, $F(5, 444) = .75$, $p = .59$. The three-way interaction between condition, time, and group was not significant, $F(10, 444) = 1.14$, $p = .33$, partial $\eta^2 = .02$, indicating that the interactive effect of condition and presentation time did not differ in the HMM, AMM, and LMM groups.

Table 6.5. *Mean error rate (%) and standard deviation for each group on different dot-probe face task conditions (adjusted for the covariates)*

Group	500ms PHappy Neutral	500ms Happy Pneutral	500ms PAngry Neutral	500ms Angry Pneutral	500ms PNeutral Neutral	500ms Neutral Pneutral	1000ms PHappy Neutral	1000ms Happy Pneutral	1000ms PAngry Neutral	1000ms Angry Pneutral	1000ms PNeutral Neutral	1000ms Neutral Pneutral
HMM	2.19	2.81	1.56	1.88	1.88	1.88	3.28	3.59	1.41	1.56	1.56	.78
	(3.58)	(3.35)	(2.68)	(3.05)	(3.05)	(3.05)	(5.48)	(4.26)	(4.06)	(2.96)	(3.22)	(2.24)
AMM	2.66	3.45	1.72	2.03	2.81	2.34	1.25	2.50	1.56	3.14	1.88	1.87
	(4.40)	(5.31)	(3.27)	(3.33)	(4.57)	(3.36)	(2.54)	(4.02)	(2.36)	(4.17)	(3.54)	(2.77)
LMM	3.59	2.38	2.50	3.59	2.21	3.19	3.50	2.81	3.13	2.35	2.81	2.81
	(4.44)	(5.42)	(3.59)	(9.27)	(3.67)	(5.13)	(7.89)	(4.57)	(5.79)	(5.68)	(7.61)	(7.40)

Table 6.6. *Mean error rate (%) and standard error for interaction between condition and group (adjusted for the covariates)*

Group	PHappy-Neutral	Happy-Pneutral	PAngry-Neutral	Angry-Pneutral	PNeutral-Neutral	Neutral-Pneutral
HMM	2.65 (.71)	3.40 (.63)	1.49 (.54)	1.92 (.84)	1.69 (.67)	1.42 (.68)
AMM	1.87 (.70)	3.04 (.62)	1.58 (.53)	2.59 (.83)	2.31 (.66)	2.11 (.67)
LMM	3.72 (.72)	2.33 (.64)	2.87 (.55)	2.77 (.86)	2.57 (.69)	2.91 (.69)

Dot-probe Word Task

For the dot-probe word task, a mixed factorial ANCOVA was used to analyse group differences between HMM, AMM, and LMM. Table 6.7 shows the mean RT for each group across conditions. There were no significant differences in performance between groups, $F(2, 91) = 1.82$, $p = .17$, partial $\eta^2 = .04$. There was no significant main effect of condition, $F(5, 442) = .62$, $p = .68$, partial $\eta^2 = .01$, and no significant main effect of presentation time, $F(1, 91) = .01$, $p = .91$, partial $\eta^2 < .001$. There was no significant interaction effect between condition and group, $F(10, 442) = 1.12$, $p = .35$, partial $\eta^2 = .02$. There was also no interaction effect between group and presentation time, $F(2, 93) = .80$, $p = .45$, partial $\eta^2 = .02$, or condition and presentation time, $F(2, 392) = 1.03$, $p = .40$, partial $\eta^2 = .01$. The three-way interaction between condition, presentation time, and group was also not significant, $F(9, 393) = 1.02$, $p = .42$, partial $\eta^2 = .02$, demonstrating that the interactive effect of condition and presentation time was the same for all groups on dot-probe word task performance.

Error rates

HMM, AMM, and LMM did not differ from each other in overall error rates, $F(2, 91) = .33$, $p = .72$, partial $\eta^2 = .01$. There were no differences in error rates across conditions, $F(5, 435) = 1.25$, $p = .29$, partial $\eta^2 = .01$ or across presentation times, $F(1, 91) = 1.82$, $p = .18$, partial $\eta^2 = .02$, There were no interaction effects between condition and group, $F(10, 435) = .86$, $p = .57$, partial $\eta^2 = .02$, condition and presentation time, $F(4, 392) = 1.03$, $p = .40$, or between group and time, $F(2, 91) = .95$, $p = .40$, partial $\eta^2 = .02$. The three-way interaction between condition, time, and group was not significant, $F(10, 432) = .96$, $p = .48$, partial $\eta^2 = .02$ (see Table 6.8 for relevant descriptive statistics), indicating that the interactive effect of condition and presentation time on error rates did not differ across groups.

Table 6.7. *Mean RT and standard deviations for each group on different dot-probe word task conditions (adjusted for the covariates)*

Group	500ms PHappy Neutral	500ms Happy Pneutral	500ms PAngry Neutral	500ms Angry Pneutral	500ms PNeutral Neutral	500ms Neutral Pneutral	1000ms PHappy Neutral	1000ms Happy Pneutral	1000ms PAngry Neutral	1000ms Angry Pneutral	1000ms PNeutral Neutral	1000ms Neutral Pneutral
HMM	414	428	426	421	419	440	439	446	450	448	440	447
	(95.38)	(94.31)	(96.93)	(80.99)	(81.75)	(75.01)	(81.86)	(85.23)	(92.50)	(94.14)	(79.07)	(89.11)
AMM	380	380	382	387	383	424	413	424	430	417	424	414
	(79.47)	(82.75)	(85.25)	(85.82)	(72.35)	(85.26)	(84.81)	(84.93)	(104.45)	(84.87)	(94.17)	(79.58)
LMM	377	383	377	382	377	408	409	420	411	411	408	416
	(79.36)	(83.29)	(75.39)	(74.93)	(73.19)	(76.91)	(79.73)	(80.23)	(80.88)	(77.88)	(74.56)	(78.63)

Table 6.8. *Mean error rate (%) and standard deviation for each group on different dot-probe word task conditions (adjusted for the covariates)*

Group	500ms PHappy Neutral	500ms Happy Pneutral	500ms PAngry Neutral	500ms Angry Pneutral	500ms PNeutral Neutral	500ms Neutral Pneutral	1000ms PHappy Neutral	1000ms Happy Pneutral	1000ms PAngry Neutral	1000ms Angry Pneutral	1000ms PNeutral Neutral	1000ms Neutral Pneutral
HMM	2.19	1.72	1.25	2.03	3.13	3.13	2.19	1.57	2.66	3.59	2.81	2.20
	(4.20)	(3.50)	(2.54)	(6.70)	(5.79)	(4.88)	(3.58)	(2.97)	(3.81)	(5.27)	(4.39)	(3.10)
AMM	1.88	2.34	2.03	2.19	1.72	2.50	1.25	1.09	2.50	1.25	2.81	1.41
	(3.05)	(3.36)	(3.07)	(3.58)	(3.27)	(3.81)	(2.20)	(2.10)	(4.58)	(2.54)	(3.35)	(2.28)
LMM	2.67	2.66	2.03	1.56	2.19	2.69	1.60	3.13	2.55	2.34	3.15	2.20
	(5.68)	(5.68)	(3.07)	(2.96)	(3.10)	(5.20)	(4.87)	(5.79)	(6.20)	(4.21)	(4.78)	(3.83)

Discussion

A dot-probe face task and a dot-probe word task were conducted to investigate the difference between media multitasking groups on selective attention to happy, angry and neutral stimuli. Results showed that on the dot-probe face task, there were no group differences in attentional bias towards negative emotional faces. This contrasted with Shukla (2016) as they had found LMM were more biased towards negative faces and this was not replicated in Study 3. Participants in the HMM group appear to have been more fixated on the happy faces. They took longer to respond to the neutral probes in the presence of happy faces (happy-Pneutral condition) than to neutral probes in the presence of neutral faces (neutral-Pneutral condition). This is consistent with Shukla's (2016) findings in that HMM had the tendency to focus on happy faces more than other groups. Since the faces were matched on ratings and intensity (Study 2), it is unlikely attributable to a mismatch on agreement ratings or arousal level.

Contrary to what was expected, HMM did not appear to be more distracted than the other groups at the longer presentation time. Apart from the group difference described above, there were no other significant differences found. This may be because of the covariates that were used to control for state anxiety and depression. Previous research in clinical populations with depression and anxiety suggests that state mood can significantly influence attentional bias at different presentation times (e.g., Bradley et al., 1997; Mogg et al., 2004; Pishyar et al, 2004). Therefore controlling for state mood would minimise group differences that could be attributed to differences in state mood. It should be noted that in the analyses without covariates, there was a significant main effect for presentation time, whereby participants were slower at the longer presentation time.

According to the relevant theories previously mentioned in this chapter (Mathews and

Mackintosh, 1998; Öhman, 1993; Williams et al., 1988), it was argued that emotional stimuli would capture attention more readily than neutral stimuli, hence produce a faster reaction time on dot-probe trials where the dot-probe appears at the emotional stimuli compared to neutral stimuli. In particular, threatening information (such as angry faces or words) would require more immediate attention than non-threatening information, and therefore be given priority so that the threat could be evaluated and acted upon. This would suggest that all participants should respond to angry stimuli faster than happy and neutral stimuli. However, this was not the case in the current findings.

There are several possible explanations for these findings (assuming the finding was not due to chance). First, only the HMM group was found to be more fixated on happy faces. This could be due to their breadth-based cognitive processing style, which then enables them to quickly assess threat, then once deemed non-threatening, be allowed to further examine the happy face. Nevertheless, given HMM were found to score higher on depression and anxiety (see Chapters 2 and 3), the current findings would be inconsistent with dot-probe studies examining clinical populations and finding that anxious (e.g., Fox, 2002; Mogg & Bradley, 2002; Pishyar et al., 2004; Vassiolopoulos, 2005) or depressed (e.g., Bradley et al., 1997; Gotlib et al., 2004; Joorman & Gotlib, 2007) participants tend to be more biased towards stimuli that are consistent with their symptomology (i.e., threat or sad stimuli).

If these clinical populations tend to seek out information that then contributes to reinforcing their clinical symptoms, then perhaps media multitaskers who are unintentionally exposed to a wide array of information simultaneously increase their chances of processing information consistent with what they are exposed to. For example, in social media, people often post happy pictures of themselves (selfies, with friends, on holidays etc), increasing exposure to happy faces and contributes to HMM' fixation on them. However, these results were not consistent on the word task. Perhaps for words, increased exposure to positive (or negative) words creates a desensitisation to them, and therefore reduces the level of attunement towards them in a nonclinical population. The difference between these changes in bias towards faces and words may be due to words being more easily subject to interpretation and dismissed, whereas happy and angry faces provide cues that are important for survival from an evolutionary perspective, and are therefore more hardwired or enduring (Fox et al., 2000).

The current findings could also be attributed to the subtlety of facial expressions chosen for this study. Previous studies that have used emotional faces in a dot-probe task have used face stimuli that may capture attention more readily due to the exaggeration of the expression (e.g., Alpers & Gerdes, 2007; Fox, 2002; Mogg & Bradley, 2002). The faces used in Study 3 were closed-mouth and black and white. This reduces the saliency of the emotion, which would require a higher level of attunement to detect the emotion, which the current sample did not appear to have.

In addition, in contrast to the current findings, previous research indicates that bias towards stimuli that is consistent with one's symptoms is also influenced by presentation time (e.g., Bradley et al., 1997; Mogg et al., 2004; Vassiolopoulos, 2005; Yu et al., 2014), likely because of the time required for either automatic or strategic processing to occur. However, this still remains consistent with the presenting symptoms. Threat is likely to be automatically processed, particularly for anxious people who are generally vigilant towards threatening information. On the other hand, depressed individuals tend to focus on negative information but in the form of rumination rather than hypervigilance, therefore biases are likely to be observed once more time has lapsed to allowed for rumination to occur (i.e., longer presentation times). Nevertheless, results from the current study do not provide evidence that the length of presentation time influences dot-probe task performance in media multitaskers if state anxiety and depression are controlled This may be because media multitasking behaviour can occur in a variety of contexts that can either occur in a short time (e.g., sending a text while responding to an email) or over a longer period (e.g., watching a movie and browsing the internet), and therefore may not necessarily enhance hypervigilance in HMM the way anxious people might be towards threat. Although it was expected that HMM would have slower RTs in the longer presentation time due to poor filtering abilities and distractibility, perhaps this was not found due to the presence of only two stimuli which may not be enough to draw attention away from the task at hand.

Another explanation for the current results in both the face and word task could be due to the task itself. The dot-probe task is a relatively simple task whereby one could focus on completing the task (identifying the dot-probe) without consideration of the actual stimuli presented. If the participants who took part had the cognitive capacity to effectively filter out information irrelevant to the task (i.e., all face and word stimuli), and only focused on looking for the dot-probe, then their cognitive resources would be allocated to accomplishing that goal. This would be consistent with the Cognitive Motivational Analysis model (Mogg & Bradley, 1998) in that the goal engagement system leads to the allocation of resources to that goal. In this situation, there was no need for interruption from the valence evaluation system because there was no significant threat present. This would also assume that the valence of the emotional faces and words was not strong enough to illicit an interruption from the system, except in the case of the biases found within the HMM group.

In summary, HMM were more fixated on happy faces than AMM and LMM. Apart from this, the current study found no other significant differences between media multitasking groups on dot-probe task performance, both in the face and word tasks. Presentation time also did not have a significant influence on dot-probe face or word task performance. These results show some relationships between media multitasking and emotion processing on a dot-probe task.

CHAPTER 7: VISUAL SEARCH TASK

Overview of the Visual Search Task: Early and General Studies

In Study 3, the visual search task was employed as one of the attention tasks in the experiment. This chapter will outline theories accounting for the visual search and review previous studies that have used this attention task across various populations. Since there have been no visual search studies done with media multitaskers to date, the review focuses on the most relevant studies which are those using a visual search task with emotional faces and words.

The visual search task (Treisman & Gelade, 1980) is a measure of spatial attention. It involves scanning through a visual environment for a target amongst an array of distractors. Participants may be instructed to locate a specific target, identify a target, or indicate whether a discrepant stimulus (target) was present or absent in the array. An example would be detecting a happy face (target) amongst a group of sad faces (distractors). Reaction time and accuracy is usually measured. Faster reaction times in detecting an emotional target amongst neutral distractors indicate a shift in attention towards that emotion. (Hansen & Hansen, 1988). Studies frequently manipulate the number of distractors in the matrix to compare spatial attention in larger arrays. It is generally expected that target detection will take longer when amongst an array with more distractors rather than just a few because more processing is required. If search time for the target is efficient even when the stimuli are featurally similar, then that indicates a bias towards that stimulus.

Initial studies have used colours, letters and shapes as target and distractor stimuli to examine spatial attention in a visual search task. For example, Treisman et al. (1977) compared search for targets defined by a single feature (e.g., colour) and for targets defined by a conjunction of features (e.g., a pink O amongst green O and pink N). Treisman and

Gelade (1980) conducted a similar experiment, except participants were asked to concurrently search for two targets that were each defined by a single feature (shape and colour). Over a series of experiments, it was concluded that stimuli are detected and identified through separable features, and these are processed in parallel. If attention is diverted or overloaded, detection is impaired. On the other hand, feature conjunctions require focal attention to process stimuli serially. Duncan and Humphreys (1989) suggested that instead of a search for features and conjunctions, search efficiency is dependent on target-distractor similarity. Increased similarity between targets and distractors led to poorer search efficiency, while less similarity led to better search efficiency. The next section describes theories that could account for the general findings on a visual search and how search efficiency is affected by different stimuli.

Theories Relevant to the Current Visual Search Task

Feature-Integration Theory.

Treisman and Gelade (1980) proposed the Feature-Integration Theory. According to this theory, integral features are processed automatically, and in parallel across the visual field. Objects are then processed at a later stage and registered separately. This requires focused attention. A visual scene is initially perceived along various separate dimensions such as colour, orientation, spatial frequency, brightness, direction of movement. Search is generally easy when a target differs from all its distractors along any feature dimension. For example, it is easy to detect a red circle amongst green circles (differ in colour). This is called feature search, where preattentive processing is sufficient for feature detection because the target has a “pop-out” effect. In conjunctive search, the target is not defined by any single feature (e.g., finding a red circle amongst red squares and green circles). For separate dimensions to be correctly combined, stimulus locations are processed serially with focal attention. Focal attention serves as the integrator for the initially separable features into a unified object. Once correctly registered, the unified object is stored into working memory. Therefore, without focused attention, separate features cannot be related to each other accurately.

This theoretical perspective, applied to emotional processing, would predict a face-in-the-crowd effect whereby emotional faces (particularly angry faces) are detected more efficiently than neutral faces. This is because the features of a threatening face create a “pop-out” effect, which is adaptive from an evolutionary perspective. In media multitaskers, it is expected that HMM would have an even greater efficiency at detecting angry faces and words compared to AMM and LMM. This may be contributed by more past experience and exposure to negative information in the media in HMM, therefore less focal attention is required to process and identify angry faces and words.

Guided Search Model.

The Guided Search Model (Wolfe, Cave & Franzel, 1989) expands on the Feature-Integration Theory by accounting for the presence of a continuum from efficient to inefficient search for preattentive processing and focal attention, rather than two separate search strategies. It also explains preattentive mechanisms that guide the deployment of focal attention effectively through providing information about the visual scene. The Guided Search Model proposes that this guidance is provided by a master map of locations, which represents the priority of attentional allocation to each location. The master map receives inputs from feature maps, which contain both top-down (user-driven) and bottom-up components (stimulus-driven). Top-down activations respond to target-matching features, while bottom-up activations respond to contrasting or physical saliency of stimuli. This accounts for efficient feature search because the target is salient (bottom-up activation) and contains target features (top-down activation).

The Guided Search Model (Wolfe et al., 1989) accounts for visual search for emotional stimuli in that emotional saliency provides bottom-up activation. Therefore, emotional faces are efficiently detected amongst neutral non-face distractors or neutral faces. However, because top-down activation is user-driven, attentional direction can be influenced by task instructions, participant state or traits, and personal relevance of the stimuli (Wolfe et al., 1989). For example, a person may show attentional biases towards happy faces under normal situations, but then become more biased towards angry faces under a stressful situation as these would be user-driven and influenced by the person's state mood and personal relevance according to the situation they were in. For this reason, Study 3 will control for state mood (depression and anxiety) to prevent showing biases that are only attributable to state mood. It is predicted that HMM would show more bias towards angry faces and words than AMM and LMM because of their attunement to negative information due to preattentive mechanisms that guide their focal attention.

Attentional Engagement Theory.

In contrast to a dichotomy of preattentive and attentive processing, the Attentional Engagement Theory (AET) is based on biased competition (Duncan & Humphreys, 1989). According to this theory, stimulus objects are represented at a perceptual level, then compete to enter visual working memory. Target-like objects gain an advantageous bias as they are most perceptually similar, and similar objects share some of this advantage. Therefore, search efficiency is predicted by two principles. Firstly, search is more efficient when target-distractors are dissimilar. This is because top-down target activation increases (see Guided Search Model). Secondly, search is less efficient when distractor-distractors are dissimilar. In this case, bottom-up signals from distractors produce more noise, thus reducing target salience. The AET is a theory that describes attentional processing that can be applied to emotional processing in a visual search task. For example, emotional targets would perceptually stand out amongst neutral distractors (bottom-up activation) and gain an advantageous bias (top-down activation) because they are dissimilar to the rest of the distractors, therefore search would be efficient. However, neutral targets would be too similar to neutral distractors, therefore search would be inefficient.

Signal Detection Theory.

The Signal Detection Theory (SDT) suggests that stimuli in a visual search display are internally represented as independent, noisy random variables (Getty et al., 1979). A matched filter is present to detect the properties of the signal (stimulus) to be detected or discriminated. When the activation threshold is reached, it generates a response to the stimulus. This is how targets are discriminated from distractors, as they will evoke a greater response in a filter as compared to the distractors. Response strength is determined by a bell-shaped distribution that is centered on a mean response value. The variance between the distributions of two stimuli determines the probability of correctly discriminating and identifying them. Equal variance would mean that the internal representations are equally noisy, while a large difference in variance would increase the discriminability between the stimuli. In a visual search, the idea is to discriminate a target from multiple distractors. When target and distractors are dissimilar, their distributions are far apart, making it easy to discriminate (Verghese, 2001). So if a target is emotional and distractors are neutral, it is easy to discriminate because their distributions are far apart. However, when both target and distractors are neutral, there is a small difference in variance, thus it is more difficult to discriminate between them.

Experience, expectations, physiological state and other factors are said to affect this threshold. For example, state anxiety could lower the threshold for threatening stimuli, therefore the presence of threatening stimuli evokes a far greater response so it is detected more easily and efficiently. According to this model, all stimuli in the search array are processed at once, and the addition of distractors only creates more noisy signals that might be mistaken for a target. Based on this model, it might be expected that HMM are more capable of processing multiple stimuli in the search array at once, given they are used to processing multiple sources of information through multitasking. However, with the addition of more distractors at larger arrays, HMM may be more vulnerable to distraction due to poorer filtering abilities compared to LMM (Ophir et al., 2009). Therefore it is expected that HMM would take longer to search the array compared to AMM and LMM, particulary as the array size increases.

Summary of theories accounting for the Visual Search

The theories explained above provide a relevant account of the visual search paradigm. The Feature Integration Theory (Treisman & Gelade, 1980) focuses on preattentive processing for feature detection and the need for focal attention for conjunctive searches. The Guided Search Model (Wolfe et al., 1989) expands on this and suggests an allocation of attention to each stimulus location based on feature maps. The Attentional Engagement Theory (Duncan & Humphreys, 1989) proposes that stimuli compete with each other for resources to enter the visual working memory and be processed further. The Signal Detection Theory (Getty et al., 1979) explains that targets are discriminated from distractors based on signal strength and difference in distribution variance. Each of these theories could potentially explain differences in visual search performance in media multitaskers. Subsequent sections will review studies involving various populations in visual search experiments using a range of stimuli, especially emotional stimuli. The focus on emotional stimuli is because Study 3 will be comparing media multitaskers on visual search task performance using emotional stimuli.

Visual Search Studies Using Word Stimuli

Study 3 includes a visual search task using emotional word stimuli (happy, angry, and neutral). Previous visual search studies have used various types of word stimuli in the search array but there has only been a few visual search studies using emotional word stimuli, and these will be included in this review. As outlined in Table 7.1, Shields and Murphy (2011) investigated high and low health anxious participants and found that participants showed attentional bias towards ill-health related words compared to other word categories regardless of their health anxiety levels. Perhaps ill-health related words are seen as more threatening than general negative words, therefore producing attentional bias. If this were to be generalised to emotional words, perhaps there would be more attentional bias towards angry words (most threat) compared to other categories (happy, neutral). Rinck et al. (2003) found that patients with generalised anxiety disorder (GAD) were more distracted by GAD-related words compared to other participants and other word types. Cohen et al. (1998) also provides support that state and trait mood can influence attentional bias on a visual search task. In Study 3, media multitaskers will be measured on depression and anxiety so that state mood can be controlled for. Study 3 will then be able to provide more insight into whether HMM are more or less efficient at finding emotional words compared to other media multitasking groups.

As there has been limited research done in the area of visual search and emotional words, Study 3 will contribute to the existing literature by examining the differences between groups of media multitaskers in specific emotion word processing using a visual search paradigm. This is also a unique contribution because no visual search study has compared differences between media multitaskers before. It is expected that the groups will differ in emotional word processing efficiency. This is because HMM have previously been found to have poor filtering and inhibition abilities (Ophir et al., 2009) as well as being susceptible to distractors. In addition, the groups tend to engage in different cognitive processing styles (breadth versus depth), and therefore may elicit performance differences particularly in larger visual search arrays. When presented with an array with one target and a number of distractors, HMM would likely be more distracted when there are more stimuli present. Therefore, as array size increases, HMM are expected to show more performance deficits such as generally poorer search efficiency compared to AMM and LMM. For attention towards specific emotions, HMM may be quicker to attend to negative information compared to AMM and LMM because of their frequent exposure to this in the media (e.g., Trussler & Soroka, 2014). However, it could also be argued that due to frequent exposure, they may also be more desensitised to emotional information and thus be slower to respond to them compared to the other groups.

Table 7.1. *Overview of visual search studies using word stimuli*

Author and Year	Sample type	Word stimuli	Procedure	Main findings
Shields & Murphy (2011)	High and low health anxious participants	Task 1: Visually similar target and distractor letters (e.g., C and O) Task 2: 5 distractor categories (ill-health related words, good-health related words, general negative words, general positive words, neutral words), neutral target words	6, 12, 18 array size Half present, half absent	All participants showed attentional bias towards ill-health related words compared to other word categories No differences between high and low health groups
Rinck et al. (2003)	Patients with GAD, speech phobia, and non-anxious control group	GAD-related, speech-related, positive, and neutral words	Matrix contains 8 rows of 26 letters	GAD patients more distracted by GAD-related words compared to other participants and other word types Speech phobia patients did not show enhancement or distraction with speech-related words
Cohen, Eckhardt & Schagat (1998)	Healthy participants – measured trait anger	Target neutral word Neutral, angry, or positive distractor words	Insult and noninsult groups to induce state anger Target word shown followed by 4 words (1 target, 3 distractors)	High trait anger participants slower to detect target when distractors were angry words, especially those in the insult group

Emotional Faces and Visual Search Performance in Healthy Participants

Early visual search studies have suggested that emotional stimuli are detected more efficiently than neutral stimuli (e.g., Hansen & Hansen, 1988). Hansen and Hansen (1988) explored visual search performance using angry, happy and neutral faces in a 3x3 matrix display. Participants had to determine if a discrepant face was in the crowd as quickly and accurately as possible. Angry faces were found more efficiently than happy and neutral faces in both neutral and emotional crowds. The authors suggest that faces can be preattentively processed for features of facial threat, and suggest a pop-out effect for angry faces due to the crowd size making no difference to its enhanced detection.

The visual search task is also referred to as the ‘face in the crowd’ paradigm when emotional face stimuli are used (Pinkham et al., 2010). As shown in Table 7.2, schematic faces and emotional faces have been shown to produce inconsistent results across visual search studies of healthy participants. This section will review studies investigating a healthy, nonclinical population using visual search tasks with faces. Evidence suggests that for healthy participants, threatening faces are detected more efficiently than non-threatening faces, for schematic (Lipp et al., 2009; Lundqvist & Öhman, 2005) and photographic stimuli (Fox & Damjanovic, 2006; Gerritsen et al., 2008; Horstmann et al., 2006; Öhman et al., 2001; Pinkham et al., 2010). Other studies have shown an advantage for happy schematic faces over angry and neutral faces (Becker et al., 2010). Gerritsen et al. (2008) also suggests that emotional meaning can be associated to face targets so that it is preattentively available for processing. Across these studies, some have used multiple array sizes, while others have only used one. Stimulus display times have varied in different studies, and distractor stimuli have also differed, with some studies using non-face distractors (e.g., Hershler & Hochs, 2005). These factors may all contribute to the inconsistencies in results across the existing literature because they influence the way people attend to information such as having more distractors to filter out or increasing the difficulty in distinguishing targets from distractors if they are similar and vice versa. In the current study, media multitasking groups will be compared on performance on a visual search task employing multiple array sizes. Similar to other nonclinical populations, it is expected that the current sample would detect emotional faces more efficiently than neutral faces, but in particular, detect angry (threatening) faces more efficiently than non-threatening (happy, neutral) faces. Given media multitaskers have been shown to have difficulty filtering irrelevant information (e.g., Ophir et al., 2009) it is expected that HMM would take longer on search times as the array size increases, compared to AMM and LMM. On the other hand, it is possible that if media multitaskers use a breadth-based cognitive processing style, they may have had more practice in processing lots of incoming stimuli at once, and therefore be better at processing displays with larger array sizes.

Study 3 compared media multitaskers on visual search task performance using emotional face stimuli. Given results have been shown to be subject to racial bias for dark-skinned men (Otten, 2016), efforts were made to reduce racial bias by removing face stimuli with actors of darker skin tone, and also ensured a gender-balanced stimulus set. Although no facial features are omitted, the emotional expressions included are more subtle than previous studies because the faces used in Study 3 have no teeth exposure. This will provide evidence as to whether attentional biases towards emotional faces are still present even in subtle expressions, and whether there are group differences between media multitaskers on a visual search task. The next section will review visual search studies using emotional faces with clinical samples.

Table 7.2. *Overview of visual search studies using emotional face stimuli with healthy participants.*

Author and Year	Sample type	Face stimuli	Procedure	Main findings
Lipp, Price & Tellgen (2009)	Healthy participants	Happy, sad, angry, scheming, neutral schematic faces 2 conditions – upright and inverted faces	3x3 matrix Stimulus display up to 6000ms	Angry and scheming faces detected faster than happy or sad faces amongst neutral face distractors for both conditions
Öhman, Lundqvist & Esteves (2001)	Healthy participants	Faces: threatening, friendly, neutral schematic faces	3x3 matrix Stimulus display either 1000ms or 2000ms	Threatening faces detected faster than friendly faces, especially when distractors were neutral. For emotional distractors, threat detection advantage only shown at 2000ms exposure.
Lundqvist & Öhman (2005)	Healthy participants	Threatening, friendly, neutral schematic faces with either 1, 2 or 3 features (eyebrows, mouth and eyes)	3x3 matrix Stimulus display until response	Threatening faces detected faster than neutral and friendly faces Effect still present when only 1 feature present. Eyebrows influenced attention more than mouth, and mouth more than eyes.
Hershler & Hochstein (2005)	Healthy participants	Target: faces (of various emotions)	Distractors: pictures of common and uncommon objects, and scenes 4x4, 6x6 or 8x8 matrices Stimulus display until response	Attentional capture of faces independent of search array size
Becker et al. (2011)	Healthy participants	Angry, happy, neutral	2, 4 or 6 faces in an array Trial for first experiment (looking for discrepant face): 10sec stimulus display Second experiment (looking for specific emotion): Same as Experiment 1 except a 500ms prompt on what to look for after fixation point	No advantage for angry faces. Happy faces detected more efficiently. Happy-face advantage found even when facial features below the nose was removed in a later experiment.
Fox & Damjanovic (2006)	Healthy participants	Angry, happy, neutral faces	3 conditions: whole-face, eye region shown only, and mouth region shown only 800ms stimulus display of 4 faces in a circle	Angry faces detected faster than happy faces for whole-face and eye region conditions, but not for mouth region condition

Pinkham et al. (2010)	Healthy participants	Angry, happy, neutral	3x3 matrix 2000ms stimulus display	Angry faces detected faster than happy faces across both emotional and neutral distractor conditions
Horstmann, Scharlau & Ansorge (2006)	Healthy participants	Positive, negative, neutral	4x3 matrix 6000ms stimulus display	Negative faces amongst positive face distractors detected better than positive faces amongst negative face distractors No difference when distractors were neutral.
Gerritsen et al. (2008)	Healthy participants	Positive label, negative label, neutral	6x8 matrix of 4, 7, 10 or 13 faces Stimulus display until response	Hostile faces detected better than peaceful faces among neutral face distractors
Hahn et al. (2006)	Younger (19-26 years) and older (60-77 years) participants	Angry, happy, neutral schematic faces	6x5 matrix of 5, 10, 15 or 20 faces Stimulus display until response	Angry faces detected faster in both groups. Younger participants were slower than older participants when distractors were angry faces. Older participants performed better when distractors were angry faces compared to happy or neutral distractors.
Mather & Knight (2006)	Younger and older participants	Threatening, sad, happy neutral schematic faces	3x3 matrix Stimulus display until response	Advantage for detecting threat faces over other emotional faces across both groups. This did not decline with age.

Emotional Faces and Visual Search Performance in Clinical Samples

Research on visual search performance using emotional face stimuli has also been conducted with clinical populations (See Table 7.3). Although Study 3 does not include a clinical sample, these studies provide insight on how existing and current mood states can influence attention to faces consistent with symptoms of the mental health condition. This may be generalised to mood states influenced by media multitasking behaviours through media exposure, social interactions etc. Futhermore, performance on a visual search task in media multitaskers may also be influenced by what previous studies have found, such as using a breadth-base cognitive processing style (Ophir et al., 2009), poor filtering abilities (Cardoso-Leite et al., 2016; Ophir et al., 2009), higher levels of depression and anxiety (Becker et al., 2013). Since anxious and depressed individuals have been shown to perform differently on visual search tasks compared to controls, anxiety and depression will be measured in media multitaskers and then used as control variables if needed to minimise the effect of mood on task performance.

Table 7.3 shows that anxiety (generalised and social anxiety) has been related to enhanced efficiency for detecting threatening faces (Byrne & Eysenck,1995; Gilboa-Schectman et al., 1999; Gilboa-Schectman et al., 2005; Hadwin et al., 2003), or difficulty disengaging from negative faces (Georgio et al., 2005) and emotional distractors (Derakshan & Koster, 2010). However, other studies of anxious participants did not show biases towards threatening faces (Derakshan & Koster., 2010; Lange et al., 2011). Overall, most studies (but not all) suggest that visual search performance in highly anxious participants is influenced by negative faces and these participants are more biased towards threat. The inconsistencies may be due to varying task instructions, displays or stimuli. If anxious people are more sensitive towards threat because it is consistent with their symptomology and regular behaviours, it may be that this level of attunement is higher than nonanxious people because of exposure and practice. Therefore, if HMM are more frequently exposed to various sources of negative faces through media forms, they may have a higher level of attunement towards negative faces compared to AMM or LMM. On the other hand, HMM may be slower to detect happy faces compared to AMM or LMM because it is inconsistent with what they are more attuned to, and therefore fail to capture attention as efficiently as in the other groups.

Studies outlined in Table 7.3 shows that participants with depression generally displayed no differences in detecting negative faces compared to healthy controls (Kaparova et al., 2005; Suslow et al., 2001; Wisco et al., 2012). However, Suslow et al. (2001) and Suslow et al. (2004) did find that depressed participants were slower to respond to positive faces than healthy controls. Although it would be expected that if depressed individuals frequently perceived information negatively, they would be more attuned to negative information as well, the inconsistent results may be due to the variations in array sizes and presentation times. Since clinically depressed people often have flat or blunted affect, and are more prone to rumination rather than vigilance, shorter presentation times may not have allowed for these participants to meaningfully process the emotions. In media multitaskers, behaviours of HMM involve frequently attending to multiple media activities with emotional content at the same time. Consistent with these behaviours, HMM may become better than AMM or LMM at searching for an emotional face, particularly threat faces, as they come across it often.

Table 7.3. *Overview of visual search studies using emotional face stimuli with clinical samples.*

Author and year	Sample type	Face stimuli	Procedure	Main findings
Derakshan & Koster (2010)	High and low anxious	Angry, happy, neutral	Circular display of 8 faces Eye movements tracked as well Stimulus display for up to 5000ms	Emotional target faces took longer to detect when distractors were emotional faces instead of neutral faces. High anxious participants took longer than low anxious participants to detect emotional target among emotional distractors
Byrne & Eysenck (1995)	High and low anxious	Angry, happy neutral	Participants prompted which face to look for Music used for state mood induction (anxious/nonanxious mood)	High trait anxious participants faster at detecting angry faces among neutral distractors than low trait anxious. No difference in detection of happy faces among neutral distractors. High trait anxious slower to detect happy faces in angry crowd, but faster to detect angry faces in happy crowds Induction of anxious mood did not impact detection times across groups and face types
Georgiou et al. (2005)	High and low anxious	Experiment 1: fear, happy, neutral faces Experiment 2: sad, happy, neutral faces	600ms face displayed Target letter appeared below, left, right or above face for 50ms Participants identified letter (X or P)	High anxious participants took longer to disengage from fearful faces (slower RT) compared to low anxious participants.
Hadwin et al. (2003)	Children with self-reported anxiety (7-10 years)	Angry, happy, neutral schematic faces	Display of 4, 6 or 8 faces	Trait anxiety enhanced angry face detection compared to happy and neutral faces.
Gilboa-Schechtman, Goa & Amir (1999)	Individuals with generalized social phobia, nonanxious controls	Angry, happy, disgust, neutral	Stimulus display until response	Social phobia participants better detection for angry than happy faces in a neutral crowd Social phobia participants slower to detect targets amongst emotional distractors compare to neutral distractors. No difference in controls.
Gilboa-Schechtman et al. (2005)	Clinically socially anxious participants, participants with	Positive, negative, neutral	9x3 crowd displays ranging from extremely approving to extremely disapproving.	Social anxiety associated with more negative evaluation of facial displays and showed faster processing of negative stimuli. Depression also associated with negative evaluation and slower

	social anxiety and comorbid depression, healthy controls		2500ms stimulus display Participants asked to evaluate displays on how approving they thought they were.	processing of positive stimuli.
Lange et al. (2011)	High socially anxious and nonanxious controls	Happy, angry, neutral	4x4 matrix Eye movements measured as well Stimulus display for either 500ms or 2500ms	Socially anxious group had more eye fixations on angry faces than control group. However, no evidence for enhanced detection times for angry faces relative to happy and neutral faces.
Suslow, Junghanns & Arolt (2001)	Depressed patients, healthy controls	Positive, negative, neutral schematic faces	Displays of 2, 4 or 6 faces 500ms stimulus display	No performance difference in detecting negative faces. No difference in RT when all faces were neutral Depressed patient slower in responding to positive target faces compared to controls
Kaparova, Kersting & Suslow (2005)	Depressed participants, healthy controls	Positive, negative, neutral schematic faces	Display of 4 faces 800ms stimulus display	Both groups detected negative faces faster than positive faces amongst neutral distractors No evidence for impaired disengagement from negative faces in people with depression
Wisco, Treat & Hollingworth (2012)	Clinically depressed, non-depressed participants	Happy, angry, sad, neutral	Display of 8 faces Stimulus display until response Participants had to find and identify discrepant face	No evidence of biased attention towards or impaired disengagement from sad faces in depressed participants. No evidence of avoidance of happy faces in depressed participants.
Suslow et al. (2004)	Unipolar depression, half with a comorbid anxiety disorder, nondepressed controls	Positive, negative, neutral schematic faces	Circle display of 8 faces 500ms stimulus display	Detection of negative faces unimpaired in depressed participants. Depressed participants with comorbid anxiety responded to positive faces slower than control participants for both negative and neutral distractors. Both depressed groups responded slower to neutral faces compared to controls.
Ashwin, Wheelwright & Baron-Cohen (2006)	Adult males with autism and Asperger's Syndrome, healthy controls	Angry, happy, neutral schematic faces	Experiment 1: 3x3 matrix of 9 faces for 1000ms or 2000ms Experiment 2 and 3: Various crowd sizes: 2x2, 3x3, 4x4 and	Overall advantage for detection of angry faces compared to happy and neutral faces in control group. Similar effects seen in clinical sample, but advantage less pronounced with larger crowd sizes and when faces were inverted.

			5x5 matrices Experiment 2 used neutral distractors only, Experiment 3 also had emotional distractors Experiment 4: Similar to Experiment 1, but used inverted faces	
Farran, Branson & King (2011)	Participants with autism/Asperger's syndrome, healthy controls	Angry, fear, sad, surprise, disgust, happy, neutral	3x3 matrix Stimulus display up to 10 secs Participants told to look for specific emotion	Happy faces produced fastest RTs across both groups. Happy and disgust faces produced highest accuracy across both groups. Fear, angry and sad faces produced slower RTs across both groups relative to other faces. Clinical group were slower compared to control group, but no difference in accuracy.

Summary of Relevant Visual Search Studies

There has been limited research done using a visual search task and emotional words, and none examining a sample of media multitaskers. Although emotional faces have been used quite extensively in visual search tasks with both clinical and nonclinical samples, no study has investigated this in relation to media multitasking behaviours. Presently, research in this area has shown that emotional faces capture attention more readily than neutral faces, however there are mixed results for which type of emotional face captures attention better than others. These mixed results have appeared across various populations. Other studies have also showed no differences between clinical and control groups (e.g., Suslow et al., 2001). The current research, Study 3, aims to fill the gap in the visual search literature by comparing a sample of media multitaskers with varying media usage levels. Given that many media activities involves either words, faces or both, I will be employing visual search tasks that examines attention to emotional words and emotional faces. It is predicted that emotional stimuli (happy/angry) would be detected more efficiently than responses to emotion-absent (all neutral) conditions. HMM are expected to perform worse than AMM and LMM at larger array sizes. It is also predicted that HMM would detect angry faces and words more rapidly than AMM and LMM.

Method

Participants

The participant characteristics and relevant media multitasking groupings were outlined in Chapter 5.

The visual search task

Participants completed a face and a word version of the visual search task. Faces were resized to 98 x 128 pixels and words were presented in capital letters in black Arial font size

36. All faces and words were presented upright with no degree of rotation. Each task consisted of 12 practice and 240 experimental trials. There were 80 trials for each display size (4, 8, 16 items) with 40 emotion-present and 40 emotion-absent trials for each display size. Each target (happy/angry/neutral) appeared amongst distractors in 20 trials for each display size. In 20 trials for each display size, only distractors were presented. Therefore the neutral target/neutral distractors and all neutral distractors conditions were both emotion absent conditions. These were included to equally balance the number of emotion present and emotion absent trials, as well as a control measure to make sure that these two neutral conditions did not differ significantly from each other. Stimuli were presented at random positions on the screen, and distractor stimuli were randomised although it was ensured that there were no repeats of the same stimulus on any trial. Target emotional faces/words only appeared twice each for every display size to reduce recognition or practice effects. Trials were presented in blocks of 80, with rest breaks between blocks. Participants were given verbal and written instructions indicating that they should identify whether an emotional face or word was present or absent (all neutral). Participants were asked to respond as quickly and accurately as they could. Each trial began with a 500ms fixation cross, then a blank screen for 250ms, followed by a display of either 4, 8, or 16 (at random) faces or words for up to 10 seconds or until participants responded. Participants responded by pressing the Right Shift key if an emotional (happy/angry) face or word was present, and the Left Shift key if an emotional face or word was absent. Search times for correct responses and accuracy were measured. Refer to Figure 7.1 and 7.2 for sample visual search trials of the face and word versions.

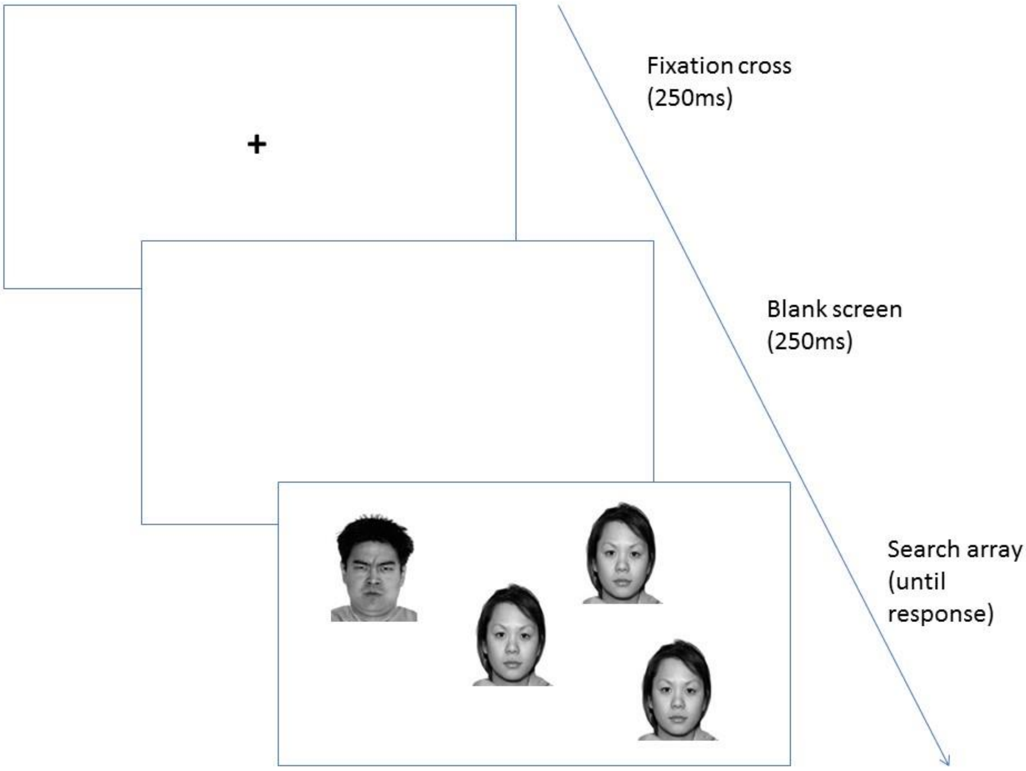


Figure 7.1. Example of a visual search face trial with four items (emotion-present – angry)

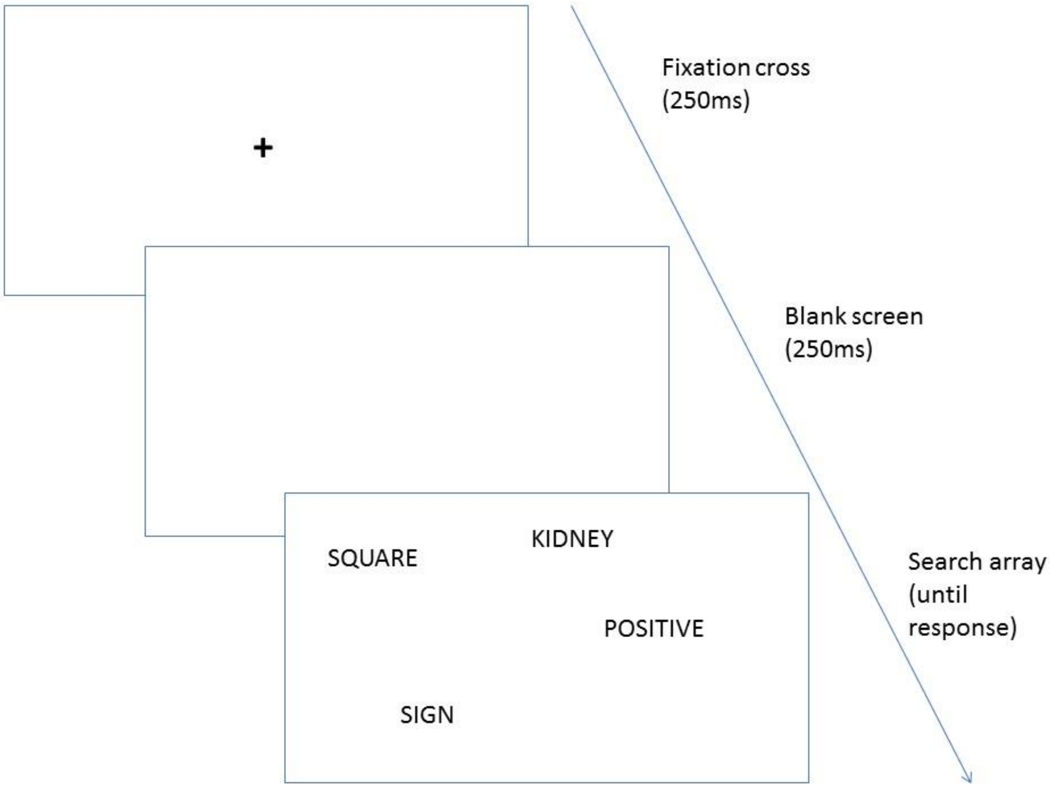


Figure 7.2. Example of a visual search word trial with four items (emotion-present – happy)

Results

A mixed factorial ANCOVA was used to analyse the data, with state anxiety and state depression as covariates. The between-subjects IV was MMI group (three levels). The within-subjects IV were conditions (four levels; happy-emotion present, angry-emotion present, neutral-emotion absent, and distractor-emotion absent) and array size (three levels; 4, 8 and 16 stimuli). The DV was search time for correct responses (ms), error rates (%), and Inverse Efficiency Score (IES). The Inverse Efficiency Score (IES; Townsend & Ashby, 1978) is a combination of speed and error scores that can inform whether a speed-accuracy trade-off has occurred. The formula for computing the IES that was used is search time divided by 1 – *PE* where *PE* refers to the proportion of error (Bruyer & Brysbaert, 2011). This analysis was conducted due to the high number of errors on emotion-present trials, where search times were significantly faster as well.

A power of 0.56 was obtained using G*Power (Faul et al., 2007) to detect a medium effect size ($f = 0.25$). A power of 0.94 was obtained to detect a large effect size ($f = 0.40$). The same analyses were run using trait depression and trait anxiety as covariates instead, as well as without any covariates (refer to Appendix C). The pattern of results was similar, therefore only the results using state depression and state anxiety as covariates will be reported here as the literature suggests that these variables are most relevant to attentional task performance (e.g., Hadwin et al., 2003; Suslow et al., 2001). The visual search face task results will be presented first, including RT and error rates, followed by the visual search word task, also including RT and error rates.

Visual Search Face Task

Search Time

ANCOVA revealed no significant effect of media multitasking group on visual search times, $F(2, 91) = .52$, $p = .60$, partial $\eta^2 = .01$. There was a significant main effect for array size, $F(1, 105) = 46.64$, $p < .001$, partial $\eta^2 = .34$, as predicted, search times increased significantly as array size increased (all *p*s < .001). There was also a significant main effect for condition, $F(1, 132) = 29.58$, $p < .001$, partial $\eta^2 = .25$ (See Table 7.4). Search times were significantly shorter when happy and angry faces were present than when they were absent (both *ps* < .001) but there was no difference in search time between happy and angry faces ($p = .54$). Unexpectedly, there was a significant difference between both emotion-absent conditions, where search times were shorter on the all neutral distractor condition compared to the neutral target/neutral distractor condition ($p < .001$). There was no significant interaction between array size and group, $F(2, 105) = .54$, $p = .61$, partial $\eta^2 = .01$. There was also no interaction effect between emotion and group, $F(3, 132) = .75$, $p = .52$, partial $\eta^2 = .02$.

An interaction effect between array size and emotion was found, $F(3, 261) = 22.58$, $p < .001$, partial $\eta^2 = .20$. Table 7.5 outlines the relevant descriptive statistics. Further analyses showed that on the four-item display, participants responded to angry faces more quickly than happy faces ($p = .03$), and emotion-absent displays (both *p*s < .001). Participants also responded to happy faces more quickly than emotion-absent displays (both *p*s < .001). Search times for all neutral distractor displays were quicker than neutral target/neutral distractor displays ($p < .001$). On the eight and 16-item displays, there was no difference between search times for angry-present and happy-present trials ($p = .60$, $p = 1.00$, respectively). However, participants responded to happy-present and angry-present trials more efficiently than emotion-absent trials (all *p*s < .001), and more efficiently with all neutral distractors compared to neutral target/neutral distractor displays ($p = .003$, $p < .001$, respectively). The three-way interaction between array size, emotion and group was not significant, $F(6, 261) = .67$, $p = .67$, partial $\eta^2 = .02$.

Table 7.4. *Mean search times (ms) and standard error for conditions (adjusted for covariates)*

Condition	Search Time (ms)
Angry emotion-present	1588 (38)
Happy emotion-present	1559 (35)
Neutral emotion-absent	2539 (65)
Distractor emotion-absent	2438 (61)

Table 7.5. *Mean search time (ms) and standard error for interaction between condition and array (adjusted for covariates)*

Condition	4 Array	8 Array	16 Array
Angry emotion-present	1176 (28)	1485 (35)	2102 (58)
Happy emotion-present	1133 (26)	1457 (33)	2086 (54)
Neutral emotion-absent	1511 (35)	2348 (58)	3759 (112)
Distractor emotion-absent	1407 (30)	2279 (59)	3629 (102)

Error Rates

Media multitasking groups did not differ on overall error rates, $F(2, 91) = 0.04$, $p = .96$, partial $\eta^2 = .002$. The main effect for array size approached significance, $F(2, 162) = 1.96$, $p = .06$, partial $\eta^2 = .02$. Further analyses showed there were significantly less errors on four and eight item displays compared to 16 item displays (both *p*s < .001), but the four and eight item displays did not differ from each other ($p = .61$). There was a main effect for condition, $F(2, 159) = 4.60$, $p = .02$, partial $\eta^2 = .05$ (See Table 7.6). Participants made more errors on emotion-present (happy, angry) trials than emotion-absent (all neutral) trials (both *p*s < .001), but the emotion-present conditions did not differ from each other ($p = .30$). There was a significant difference in error rate between the emotion-absent conditions ($p = .03$) although both error rates were very low. Interaction effects between array size and condition,

$F(5, 410) = 0.54$, $p = .73$, partial $\eta^2 = .01$, array size and group, $F(4, 162) = 0.37$, $p = .81$, partial $\eta^2 = .01$, condition and group, $F(4, 159) = .48$, $p = .73$, partial $\eta^2 = .01$, and array size, condition, and group, $F(9, 410) = 0.77$, $p = .64$, partial $\eta^2 = .02$, were all non-significant.

Table 7.6. *Mean and standard error for conditions (% error rate)*

Condition	Error rate
Angry emotion-present	11.01 (.84)
Happy emotion-present	12.36 (1.01)
Neutral emotion-absent	2.19 (.45)
Distractor emotion-absent	1.37 (.41)

Inverse Efficiency Score (IES)

Results showed that there was no significant difference in IES between media multitasking groups, $F(2, 91) = .58$, $p = .57$, partial $\eta^2 = .01$. IES was significantly larger as array size increased, $F(1, 109) = 51.10$, $p < .001$, partial $\eta^2 = .36$. Results also showed a significant main effect for condition, $F(2, 139) = 11.15$, $p < .001$, partial $\eta^2 = .11$. Both emotion-present conditions had significantly lower IES than emotion-absent conditions (all *ps* < .001), but the emotion-present conditions did not differ significantly from each other ($p = 1.00$). However, there was a significant difference between the emotion-absent conditions where IES was lower in the all neutral distractor condition compared to the neutral target/neutral distractor condition ($p < .001$). There was no significant interaction between array size and media multitasking group, $F(2, 109) = .83$, $p = .46$, partial $\eta^2 = .02$, and there was no interaction effect between condition and group, $F(3, 139) = .53$, $p = .67$, partial $\eta^2 = .01$.

An interaction effect between array size and condition was found, $F(3, 248) = 12.65$, $p < .001$, partial $\eta^2 = .12$. Refer to Table 7.7 for the relevant descriptive statistics. Happy-present and angry-present displays both produced lower IES than emotion-absent displays (all *p*s < .002). IES for all-neutral-distractor displays was lower than neutral target/neutral distractor displays (all *ps* < .009). The three-way interaction between array size, condition and group was not significant, $F(5, 248) = .72$, $p = .62$, partial $\eta^2 = .02$. The pattern of results for IES was similar to the search times analyses, therefore it is unlikely that a speed-accuracy trade-off accounts for the results.

Table 7.7. *Mean IES and standard error for interaction between condition and array*

Condition	4 Array	8 Array	16 Array
Angry emotion-present	1300 (36)	1664 (48)	2534 (92)
Happy emotion-present	1290 (42)	1687 (53)	2553 (76)
Neutral emotion-absent	1557 (40)	2395 (62)	3892 (125)
Distractor emotion-absent	1423 (31)	2308 (62)	3740 (114)

Visual Search Word Task

Search Time

In the visual search word task, there was no significant effect of media multitasking groups, $F(2, 91) = .53$, $p = .59$, partial $\eta^2 = .01$. As expected, search time increased significantly as array size increased, $F(1, 110) = 55.36$, $p < .001$, partial $\eta^2 = .38$. Results also found a significant main effect for condition, $F(2, 151) = 25.60$, $p < .001$, partial $\eta^2 = .22$ (See Table 7.8). Participants had significantly shorter search times when a happy or angry word was present than when all the words were neutral (both *ps* < .001). Participants were also faster at searching for a happy word compared to an angry word (p = .001). There was an unexpected significant difference between both emotion-absent trials (p < .001), where search time was faster on the all neutral distractor condition compared to the neutral target/neutral distractor condition. There was no significant interaction between array size and media multitasking group, $F(2, 110) = .86$, $p = .45$, partial $\eta^2 = .02$, and there was no interaction effect between condition and group, $F(3, 151) = 1.68$, $p = .17$, partial $\eta^2 = .04$.

An interaction effect between array size and condition was found, $F(3, 302) = 25.07$, $p < .001$, partial $\eta^2 = .22$ (See Table 7.9). Further analyses showed that on the four-item display, participants showed no difference in search times between angry-present and happy-present trials (p = .13). Happy-present and angry-present displays both produced faster search times than emotion-absent displays (both ps < .001). Search times for all-neutral-distractor displays were quicker than neutral target/neutral distractor displays (p < .001). On the eight but not the 16-item displays, search times were shorter on happy-present compared to angry-present trials (p < .001, p = .07, respectively). Participants also had shorter search times on happy-present and angry-present trials compared to emotion-absent trials (all ps < .001). On the eight-item display, participants were more efficient on the all-neutral-distractor trials compared to neutral target/neutral distractor displays (p < .001), but there was no significant difference on the 16-item display (p = .78). The three-way interaction between array size, condition and group was not significant, $F(7, 302) = 1.74$, $p = .10$, partial $\eta^2 = .04$.

Table 7.8. *Mean search time (ms) and standard error for conditions*

Condition	Search Time (ms)
Angry emotion-present	1677 (50)
Happy emotion-present	1586 (42)
Neutral emotion-absent	2507 (61)
Distractor emotion-absent	2432 (61)

Table 7.9. *Mean search time (ms) and standard error for interaction between condition and array*

Condition	4 Array	8 Array	16 Array
Angry emotion-present	1151 (34)	1579 (50)	2300 (71)
Happy emotion-present	1123 (31)	1442 (40)	2195 (64)
Neutral emotion-absent	1380 (36)	2316 (61)	3824 (97)
Distractor emotion-absent	1302 (32)	2211 (57)	3781 (102)

Error Rates

Media multitasking groups did not differ on overall error rates, $F(2, 91) = 0.38$, $p = .69$, partial $\eta^2 = .01$. There was no main effect for array size, $F(2, 182) = 1.77$, $p = .17$, partial $\eta^2 = .02$. or condition, $F(2, 146) = 2.41$, $p = .11$, partial $\eta^2 = .03$. There was no significant interaction effect between array size and condition, $F(5, 435) = 1.53$, $p = .18$, partial $\eta^2 = .02$, array size and group, $F(4, 182) = 0.50$, $p = .74$, partial $\eta^2 = .01$, condition and group, $F(3, 146) = 1.23$, $p = .30$, partial $\eta^2 = .03$, and array size, condition, and group, $F(10, 435) = 0.56$, $p = .84$, partial $\eta^2 = .01$, were all non-significant.

Inverse Efficiency Score (IES)

Results showed that there was no significant difference in performance between media multitasking groups, $F(2, 91) = .09$, $p = .91$, partial $\eta^2 = .002$. IES was significantly larger as array size increased, $F(1, 110) = 34.04$, $p < .001$, partial $\eta^2 = .27$. Results also found a significant main effect for condition, $F(2, 142) = 5.69$, $p = .01$, partial $\eta^2 = .06$. Both emotion-present conditions had significantly smaller IES than emotion-absent conditions (all *ps* $< .004$). Participants were more efficient in the happy-present condition compared to the angry-present condition ($p = .02$). There was also a significant difference between the emotion-absent conditions where IES was smaller in the all neutral distractor condition compared to the neutral target/neutral distractor condition ($p < .001$). There was no significant interaction between array size and media multitasking group, $F(2, 110) = .61$, $p = .58$, partial $\eta^2 = .01$.

The interaction effect between condition and group approached significance, $F(3, 142) = 2.49$, $p = .06$, partial $\eta^2 = .01$ (see Table 7.10). Further comparisons showed that in all conditions, media multitasking groups did not significantly differ from each other on IES scores (all *p*s > .28). Within the HMM group, participants were significantly more efficient in emotion-present conditions compared to emotion-absent conditions (all *p*s < .002). In the AMM group, participants were more efficient in the happy emotion-present condition compared to all other conditions (all *p*s < .03), however they were not significantly more efficient in the angry emotion-present condition compared to emotion-absent conditions (both *p*s > .32). In the LMM group, participants were only more efficient in the happy emotion-present condition compared to the neutral target/neutral distractor condition ($p = .04$), and there were no other significant differences between conditions within the LMM group (all *p*s > .13).

An interaction effect between array size and condition was found, $F(3, 236) = 10.40$, $p < .001$, partial $\eta^2 = .10$. Refer to Table 7.11 for the relevant descriptive statistics. Further analyses showed that on the four-item display, participants showed no difference in search times between angry-present and happy-present trials ($p = .62$). There was also no significant difference between both emotion-present conditions and the emotion-absent conditions (all *ps* > .43). Search times for the four-item all neutral distractor displays were quicker than neutral target/neutral distractor displays ($p < .001$). On the eight-item trials, participants responded more quickly on happy-present compared to angry-present trials, but not on the 16-item trials ($p = .01$, $p = .08$, respectively). On both the eight and 16-item trials, participants responded to happy-present and angry-present trials more efficiently than emotion-absent trials (all *p*s <

.002). On the eight-item display, participants were more efficient on the all-neutral-distractor trials compared to neutral target/neutral distractor displays ($p < .001$), but there was no significant difference on the 16-item display ($p = 1.00$). The three-way interaction between array size, condition and group was not significant, $F(5, 248) = .72, p = .62$, partial $\eta^2 = .02$.

Table 7.10. *Mean IES and standard error for interaction between condition and group*

Condition	HMM	AMM	LMM
Angry emotion-present	2022 (189)	2220 (186)	2231 (192)
Happy emotion-present	1931 (152)	1925 (250)	2074 (155)
Neutral emotion-absent	2773 (128)	2544 (126)	2455 (130)
Distractor emotion-absent	2665 (120)	2420 (118)	2381 (122)

Table 7.11. *Mean IES and standard error for interaction between condition and array*

Condition	4 Array	8 Array	16 Array
Angry emotion-present	1392 (61)	2006 (110)	3076 (161)
Happy emotion-present	1331 (58)	1770 (77)	2829 (136)
Neutral emotion-absent	1416 (41)	2379 (70)	3977 (114)
Distractor emotion-absent	1313 (33)	2235 (58)	3918 (126)

Discussion

A visual search task was employed as one of the three attentional tasks in Study 3. State anxiety and state depression were used as control variables as previous research has shown these to be related to attentional biases towards certain types of emotional information in clinical and nonclinical populations (Becker et al., 2011; Hadwin et al., 2003; Suslow et al., 2001). Results showed no significant overall group differences in search times or IES, and therefore did not provide support for the hypothesis that HMM would perform more poorly than AMM or LMM. As predicted, search time increased as array size increased across all groups. In addition, search times were significantly quicker when an emotional target was present compared to when all stimuli were neutral, which is consistent with standard task effects. In the face task, there was no difference between search time for happy-present and angry-present trials. However, in the word task, participants responded more quickly to happy words than angry words.

Previous studies have demonstrated media multitasking group differences on other cognitive tasks such as filtering tasks, task-switching, and working memory (Cardoso-Leite et al., 2016; Ophir et al., 2009; Ralph & Smilek, 2017) and cognitive ability in general has been linked to visual search task performance (Matthews et al., 2014). It may be that, contrary to what was expected, media multitasking behaviours does not have a significant influence on emotion processing or response efficiency on a visual search task. Alternatively, there may be other influencing factors such as how long these media multitasking behaviours have been ongoing for. If engaging in media multitasking over a prolonged period of time can alter an individual's cognitive processing style, then it is possible that the HMM group in the current sample have not been media multitasking at that level for a long enough period to produce significant emotion processing deficits. Longitudinal data would be useful in determining whether sustained engagement in media multitasking would significantly impact visual search performance over time and how much time is required for this to potentially occur.

Another possible explanation for the absence of group differences could be that different media multitasking groups employed varying strategies during the visual search that are in line with their cognitive processing styles. HMM have been suggested to use a bottom-up processing style that involves a breadth-based way of processing information (Ophir et al., 2009). In this case, that could mean that when the stimulus display is presented, HMM take in multiple stimuli at once and depend on discrepant stimuli standing out from others to detect the presence of a target. Although this method involves looking at sections at a time, it may have taken HMM a longer time to process and make a decision due to their distractibility and the lack of discriminability between subtle emotional targets and neutral distractors. On the other hand, LMM use a top-down processing style (Ophir et al., 2009), which involves narrower task focus. Therefore, when the stimulus display is presented, LMM may methodically scan through one stimuli at a time and then decide whether they are task relevant or not (i.e., emotional or neutral). Based on these differences, it could be suggested that AMM use a combination of both processing styles and are perhaps more flexible in switching between using more of one style when a task demands it. Although a previous study (Cardoso-Leite et al., 2015) has found that AMM outperformed HMM and LMM on cognitive tasks, this was not supported in the current research. Perhaps these variations in cognitive processing style between media multitasking groups elicit differences on certain cognitive tasks (such as working memory, task switching, and filtering), but does not significantly affect emotional processing on a spatial attention task.

Although emotion-present trials had faster search times than emotion-absent trials, which is a standard finding, it appears the level of intensity on the emotional faces affects detection and identification. This is evident in the high error rates on emotion-present trials on the face task compared to emotion-absent trials because the emotional face stimuli had more subtle face cues (closed-mouth, black and white) than previous studies. Consistent with the Attentional Engagement Theory (Duncan & Humphreys, 1989), this increases the likelihood that participants overlook emotional targets because they look similar to the neutral distractors. This is further supported by the Signal Detection Theory (Getty et al., 1979) which suggests that all stimuli in the visual search is processed at the same time, and differences in variances between stimuli determine discriminability and identification. If the emotional targets and distractors have a small difference in variance, then they are less discriminable and may miss being identified as an emotional target, thus resulting in a high error rate on emotion-present trials. In contrast, it could be that because the emotional words that were chosen (in Study 2) for use in the current study were of a high-rated intensity, the error rates were not significantly different for emotion-present trials compared to emotion-absent trials.

In the word task, participants responded more quickly to happy-present displays than angry-present displays. This indicates that participants were more biased towards happy words than angry words. Although there are no comparable visual search emotional word studies, these results contrast previous research showing that threatening information such as ill-health words (Shields & Murphy, 2011) and threat faces (Fox & Damjanovic, 2006; Gerritsen et al., 2008; Lipp et al., 2009; Lundqvist & Öhman, 2005) are detected more efficiently than non-threatening information, even in nonclinical populations. An account for these results could be that people have become more desensitised to negative or threat words due to the increasing prevalence of such content in social media and other media forms that people frequently use. This would decrease the perceived saliency of angry words, making them harder to detect, particularly where speed is required. People who are highly desensitised to negative words may even view them as neutral when scanned quickly, which would further reduce search efficiency. Perhaps this did not apply to negative faces because there is less ambiguity in the interpretation of emotional faces. Alternatively, the bias towards happy words could be explained by the recent trend in focus on self-care, health, and positive lifestyles in the media which could lead to people trying to have more positive thoughts and self-talk strategies to maintain happiness.

An unexpected finding emerged where search times for emotion-absent conditions were significantly different. Participants responded more quickly to the all neutral distractor condition compared to the neutral target/neutral distractor condition. One possible explanation for this could be that a Type I error occurred. It is also possible that given the set of distractors were used across all trials, they would have appeared more frequently than the neutral targets, hence leading to an increase in recognition or familiarity with the distractor faces and words. This might result in a slight increase in search efficiency on the all neutral distractor condition compared to the neutral target/neutral distractor condition which has one less familiar stimulus.

In summary, the current study found no significant differences between media multitasking groups on visual search task performance, both in the face and word tasks. Overall, participants' search times increased as array size increased. Participants also responded more quickly when emotional stimuli were present than absent, which was to be expected. However, the findings do not provide evidence for impaired or enhanced performance in any of the media multitasking groups. Although there were no attentional differences between media multitaskers on spatial attention, other results may emerge on a measure of temporal attention. The next chapter will outline the attentional blink (AB) task that was conducted as a part of Study 3.

CHAPTER 8: ATTENTIONAL BLINK (AB) TASK

Overview and General Studies of the AB

An experimental technique known as rapid serial visual presentation (RSVP) has been widely used to understand temporal attention. It will be used in Study 3 as one of the attentional tasks to measure attentional biases in emotion processing. This chapter will outline theories accounting for the AB and review previous studies that have used this experimental technique across various populations and using a range of stimuli. The chapter will pay particular attention to studies that have used emotional face and emotional word stimuli, as these were used in Study 3 to compare media multitasking groups on their performance in identifying emotional faces and words.

The RSVP paradigm involves participants viewing a series of items presented sequentially in the same location. Targets are located within this stream of items, which mainly contains distractors. Sometimes, participants are asked to identify whether a single target was present or absent, and if present, to identify what it was. Generally, people perform well on these tasks (Broadbent & Broadbent, 1987). However, when the RSVP stream contains two targets for report, there is a deficit in reporting the second target (T2; Broadbent & Broadbent, 1987). This T2 deficit is known as the attentional blink (Raymond, Shapiro & Arnell, 1992), and occurs when the stimulus onset asynchrony (SOA) between the first target (T1) and T2 is between 200 to 500ms (e.g. Anderson, 2005; Raymond et al., 1992; Vermeulen, 2010)[2]. However, when T2 follows immediately after T1 (within 100ms), performance for identifying T2 is as good as at long intervals (SOAs) between T1 and T2 (Hommel & Akyürek, 2005; Visser et al., 1999). This is known as Lag-1 sparing.

---

[2] SOA refers to the period of time between the onset of one stimulus (e.g., T1) and the onset of another stimulus (e.g., T2). For example, in an AB task, an SOA of 100ms indicates that T2 is presented 100ms after T1 has appeared.

The AB occurs because the human brain is not attuned to focusing on multiple things simultaneously. Hence, when the T1 is presented, attention is activated but requires time and effort to process the information. During this time, if T2 is presented, there are insufficient resources available to process the new information. Thus, T2 is not processed and a "blink" occurs (Shapiro et al., 2006; Ward et al., 1996).

Multiple studies have used different stimuli, and have consistently reported the typical AB effect. In one of the earliest AB studies Raymond et al. (1992) used single alphabet letters and asked participants to name the white target letter, as well as the three letters after. The AB was found for letters presented 180 to 450ms after the first target. The AB was also found when letters and colour words were used as targets among neutral word distractors (MacLean & Arnell, 2010). Other studies using alphabet letter stimuli also supported the presence of an AB in both clinical and nonclinical samples (e.g. Arnell & Stubitiz, 2010; Morrison et al., 2016; Rokke et al., 2002). Across three experiments using clear and blurred upright and inverted faces, Eagles and Murphy (2016) found an AB effect regardless of condition.

In addition to the traditional AB effect, a recent study further explored this in relation to an AB effect using emotional stimuli before and after the target (Choisdealbha et al., 2017). This is known as a forward emotional attentional blink (EAB) and retroactive EAB. Emotional stimuli were gory or erotic pictures of people. In the single target task (forward EAB), the target (rotated landscape) appeared at either Lag 2 or Lag 8 after the critical distractor (neutral, gory or erotic picture of people). Participants had to detect the presence of a target. In the dual target task (retroactive EAB), T1 was the rotated landscape, and T2 was a neutral, gory, or erotic picture. Participants had to answer questions about which way the landscape was rotated, whether they saw a person, and if they did, whether the person was clothed, naked, or injured. Results from the single target task reaffirmed the traditional (forward) EAB affect, demonstrating the attentional capture of emotional stimuli can impair detection of stimuli that follows it. However, the results from the dual target task did not show a traditional AB effect. Here, T1 had little effect on T2 detection. Furthermore, T1 report was impaired when T2 at Lag 2 was emotional (gory/erotic) compared to when T2 was neutral. This further demonstrates the power of emotional stimuli in capturing attention, but also highlights some contrasting results within the literature when task stimuli or requirements are different. In Study 3, the AB task used target combinations where T1 or T2 was an emotional stimulus while the other target was neutral. Following Choisdealbha et al. (2017), it was expected that when T1 is an emotional stimulus, T2 reporting should be impaired, but when T2 is an emotional stimulus, T1 reporting would be impaired.

Main Theories Accounting for the AB

This section will cover the main theories explaining how the AB phenomenon occurs. It also provides accounts of the Lag-1 sparing effect. A review paper by Dux and Marois (2009) provided detailed explanations of AB theories and was referred to in the compilation of relevant theories in this section.

Gating Theory.

Raymond et al. (1992) explained the AB using an inhibition model that included a suppressive mechanism that reduces feature confusion between targets and distractors by inhibiting post-target stimuli. They suggested that in an RSVP stream with two targets, attention is triggered when target-relevant features are detected in T1 (e.g. upright). In this process a ‘gate’ opens so that T1 can enter and its emotion be identified. To reduce interference and increase the accuracy of T1 report, stimuli following T1 are suppressed at an early perceptual level. That is, the ‘gate’ closes after T1 has entered, and remains closed until T1 has been completely processed and identified. Therefore, the AB occurs when T2 is presented close in time to T1 (i.e., within 500ms) because T2 is inhibited while T1 is still undergoing the process of identification. At longer temporal intervals (i.e., more than 500ms) after T1 has been identified, the gate is reopened and T2 can enter for identification. The Gating Theory claims that Lag-l sparing occurs because both targets enter the gate together due to their very close temporal proximity, and undergo the identification process together. Hence, Lag-1 sparing occurs when T2 immediately follows T1 without an intervening distractor between targets.

Interference Theory.

Shapiro et al. (1994) challenged the idea that T1 identification was essential to produce the T2 deficit, and found that the deficit occurred even when T1 only required detection. In other words, the presence or absence of the target determines whether an AB occurs. This contradicts Raymond et al.'s (1992) Gating Theory, which claims that inhibition of T2 during T1 identification leads to the AB. To account for their findings, the authors proposed the Interference Theory (Shapiro et al., 1994). This theory assumes that every stimulus presented in the RSVP stream establishes initial perceptual representations. Based on the task instructions, these representations are compared with selection templates. Those that are relevant or closely match the templates are selected and registered in visual working memory. When stored in working memory, each stimulus is given a weighting depending on the available space and its resemblance to the template. Usually, each target and the post-target item enter the working memory (i.e., T1 + 1 and T2 + 1).

According to the Interference Theory, an AB occurs when targets are separated by a short interval and T2 receives a weakened weighting due to working memory's limited capacity. If T1 is an emotional target, it is given a stronger weighting, and thus further weakens the weighting of a neutral T2. This leaves it vulnerable to interference from other items in the visual short term memory store, and reduces its chances of being accurately reported. The lack of AB at longer lags occurs because visual short-term memory is cleared after sufficient time has passed and no demand is made on it. Since HMM have poor filtering abilities (e.g., Ophir et al., 2009), it is expected that there would be even more susceptibility for interference from distractors, hence further impairing T2 detection compared to AMM and LMM. The theory suggests that Lag-1 sparing occurs because stimulus interference is reduced when T2 appears directly after T1 since only three items enter visual working memory at one time (T1, T2, and T2 + 1). Therefore the characteristics of the T1 + 1 (the first target and the item following it) stimulus determines whether the Lag-1 sparing occurs, rather than the temporal gap between the two targets. This also implies that higher relevance of the T1 + 1 stimulus characteristics to the selection template leads to less interference, and thus a greater chance of T2 entering the visual working memory.

Two-Stage Processing Model.

The Two-Stage Model claims that further processing beyond visual perception is necessary for target identification and the AB occurs because of limited capacity of this later stage. As this model focuses on categorically defined targets, it disputes Raymond et al.'s (1992) Gating Theory, which focuses on perceptually defined targets (Dux & Marois, 2009). Chun and Potter (1995) observed an AB when targets were defined categorically instead of perceptually, and showed that categorically and featurally similar targets and distractors can modulate the AB. Categorically defined targets (e.g. identifying two black words amongst black non-word distractors) may require more cognitive processing as opposed to perceptually defined targets (e.g. white targets among black distractors) because individuals need to focus on all items in the stream and discriminate which ones are target-relevant.

In Stage 1 of the model, the stimulus activates attention and recognition occurs rapidly based on a stored conceptual representation. Here, selection follows feature cues (such as colour) or categorical identity (such as an upright face amongst upside-down faces). During Stage 1, the information is vulnerable to decay and overwriting because it has not yet been processed and stored into short-term memory. The first stage processing alone, is insufficient for subsequent report or response, so further processing is needed. To avoid being overwritten, the stimulus undergoes Stage 2 processing, where the stimulus is encoded into working memory. This stage is activated after relevant target features have been identified in the first stage, hence prompting a transient attentional response that progresses to enhance target encoding into working memory. The Two-Stage Model claims that the AB occurs via the limited-capacity second stage of processing. Consequently, when T2 appears in close succession to T1, T2 has to wait until Stage 2 processing of T1 is completed before being encoded into working memory. As a result, T2 is more prone to decay and interruption by other stimuli, such as distractors, so an AB occurs. Lag-1 sparing occurs because due to the timing of presentation and resolution of Stage 2 processing, T1 and T2 (at Lag 1) are processed together. This can occur because T1 has not undergone Stage 2 processing yet, therefore T2 can also prompt an attentional response at Stage 1 concurrently with T1. The second stage process identifies and consolidates both targets, therefore producing comparable performance in target identification for both targets.

Therefore it is expected that a T1 emotional stimulus (happy/angry) would activate attention and enter stage 2 processing for emotion identification. As a result, T2 neutral detection would be impaired because it has to wait for the processing of T1 to be completed, and becomes vulnerable to interruption by distractors in the stream. However, if they appeared in close succession, particularly if T1 and T2 are featurally and categorically similar (i.e., neutral-neutral emotion), then target identification for both would be improved because they can be processed together at both stages.

Overinvestment Hypothesis.

The overinvestment hypothesis (Olivers & Nieuwenhuis, 2005) claims that the AB occurs because of an overinvestment of attentional resources in stimulus processing. According to this model, stimulus processing occurs in a similar sequence as the Two-Stage Model. A target (T1 or T2), receives attentional resources upon detection. If its activation exceeds an activation threshold, the stimulus gains access to a second stage, which is necessary for later target report. This second stage has a limited capacity that only allows up to a few items to be processed simultaneously. The overinvestment hypothesis states that by only focusing on identifying targets, too many attentional resources are allocated to the RSVP stream. This results in not only the selection of targets, but also leads to distractors receiving attention, especially when presented in close proximity to targets. Hence, at the second stage of processing, T2 accuracy is reduced (causing an AB) due to an overwhelming influx of rapidly succeeding items after T1 (e.g., distractors). T1 accuracy may also be compromised, but to a lesser extent because more resources were already allocated when it was first detected (Olivers & Nieuwenhuis, 2006). If an additional task is introduced, attention is dispersed and widened, improving T2 report. Although a degree of focused attention is known to be advantageous in most real life activities, target objects are usually relatively stationary, or at least unlikely to be replaced in such rapid succession (as seen in the AB task). Therefore, contrary to a mainstream belief that full dedication to a task will result in optimal performance, the overinvestment hypothesis claims that an intermediate level of attention may actually be more beneficial to the goal-driven task (Dux & Marois, 2009).

Since the AB task used in Study 3 does not have an additional task introduced, it is expected that participants are likely to "overinvest" in the task and be prone to distraction from all items, both targets and distractors, in the stream. T1 emotional target would likely take up more resources, leaving less resources for T2 to be detected and identified. However, if T1 is neutral and T2 is emotional, then T2 may be allocated more resources and be processed at stage two, thus reducing the AB. According to this theory, LMM may be more prone to “overinvest” in the task because they are more used to focusing on single tasks while HMM may only invest an intermediate level of attention on the task as they are used to attending to multiple tasks concurrently, which may include being distracted by other thoughts unrelated to the AB task. If this is the case, then LMM may perform more poorly compared to AMM and HMM.

Temporary Loss of Control (TLC) Hypothesis.

Di Lollo et al. (2005) proposed the Temporary Loss of Control (TLC) hypothesis to account for the AB when their findings were inconsistent with the limited-capacity models (e.g., Chun & Potter, 1995). The TLC hypothesis suggests that an input filter is configured to pass target-relevant items and exclude non-target items. Once a target-relevant item has been detected and identified, the maintenance signals for this monitoring task are discontinued, and the input configuration can be affected by the following stimuli. If the following stimulus is from the same category as the first target (e.g., A-B), the configuration remains the same, allowing efficient processing and consequently recall accuracy is only limited by short-term memory span. On the other hand, if the trailing stimulus belongs to a different category to the first target (e.g., A-2), it will take longer to process because it does not match the configuration of the input filter. In addition, the configuration of the input filter will be disrupted, therefore even subsequent stimuli belonging to the same category as the first target will be processed inefficiently, causing an AB. Therefore, this theory suggests that an AB occurs because of limited-control over the input filter of the visual system, which appears to be vulnerable to externally-triggered loss of control when differences in stimulus category disrupt target-monitoring mechanisms.

The TLC hypothesis contradicts a limited-capacity account, suggesting that there are sufficient resources to process multiple targets in close succession. The model proposes that the AB may be due to a temporary disruption of control at the executive level where only one task aspect (target identification, input control) can be actively handled at any given time (Di Lollo et al., 2005). In Study 3 using emotional stimuli, T1, T2 and distractors are from the same category (all faces or words), they can be efficiently processed because they are from the same category and the input filter configuration does not need to be disrupted. However, the AB would occur because not only does a target need to be identified, but it needs to be processed to determine its emotional content. Therefore a temporary disruption of control would occur because of this two level task. The TLC model accounts for Lag-1 sparing by stating that with the sequential presentation of targets from the same category, the input filter is not disrupted. Therefore, both T1 and T2 are processed efficiently.

Boost and Bounce Theory.

The Boost and Bounce theory by Olivers and Meeter (2008) proposed that a constantly responding attentional filter aims to enhance relevant information and suppress irrelevant information within the RSVP stream. There are two main stages in this model: sensory processing and working memory. At the sensory processing stage, both the perceptual features (e.g. colour) and high-level semantic and categorical representations (e.g alphabets versus digits, or word vs non-word) are activated. Due to forward and backwards masking, each item's activation strength depends on the stimuli around it. Forward masking refers to a masking stimulus (typically a distractor) preceding another stimulus (i.e., target), while backwards masking refers to a masking stimulus immediately following another stimulus (i.e., target followed by distractor).

When an emotional T1 stimulus adequately matches the target description (i.e., upright face or black word), a "boost" function occurs, prompting transient excitatory feedback activity so that the stimulus can access working memory. In this model, working memory plays several roles. First, it establishes an attentional set depending on the task instructions. Secondly, it stores encoded representations, so that items can be reported when a response is required. This is also required in the reporting of the emotion of the stimulus. Most importantly, working memory also uses an input filter that enhances the processing of stimuli that match the target set and inhibits irrelevant stimuli (i.e., distractors). This input filter is able to restrict working memory access to distractors that are presented before T1 appears, hence also boosting the visual input of T1. Due to temporal proximity, the T1 + 1 item also benefits from this enhancement and receives a strong attentional boost even though it is a distractor from a different attentional set than the target. This causes a strong inhibitory feedback response (a "bounce"), which affects subsequent stimuli, therefore causing an AB if T2 is presented before the inhibition has dissipated. According to the Boost and Bounce Theory, Lag-1 sparing occurs because of the duration of T1's attentional boost. Therefore when T2 appears at a short SOA after T1, it is at the peak of the boost and can also be detected efficiently.

Threaded Cognition Model

The threaded cognition model was developed by Salvucci and Taatgen (2008) and accounts for multitasking behaviours. In this model, it is assumed that cognitive modules can operate in parallel, however, a single module can only be used for a single task. This model suggests that threads are coordinated by a serial procedural resource that combines inputs from other resources and initiates new processing on these resources. A thread will take the resource it needs if the resource is available, and let go of the resource when it is no longer needed. The modules are proposed in the following sequence. First, a cognitive resource (e.g., visual, auditory, motor control) module perceives the stimulus input. In the AB task, the visual module is needed to perceive the stream of items. Procedural memory is then represented by production rules, and are translated into actions. Declarative memory is the factual knowledge that is used to determine the production rules, and is used to determine, for example, whether an item in the AB is a target or distractor. The imaginal module then acts as a limited working memory store, and is required for memory consolidation. According to this model, an AB occurs due to overexertion of control whereby a production rule dictates that target detection is blocked during memory consolidation (Taatgen et al., 2009). Therefore an AB occurs because T1 only lets go of the resources needed to detect it when they are no longer needed. Since the same resources are needed to process T2, when T2 is presented while T1 is still being processed, T2 cannot be processed. However, in the case of Lag-1 sparing, T2 is recognised by a production that replaces the production that is blocking target detection during consolidation. Therefore T2 is held on to while T1 consolidates, and can be consolidated once T1 is finished consolidating.

According to this model, both emotional targets and distractors (faces and words) would require the visual module to be used to perceive the stimulus input. The production rules will then determine if an item is a target (fits task description) or distractor. When the production rule identifies T1 as a target, further target detection is blocked while T1 is being processed for emotion identification, therefore causing an AB because T2 cannot be detected. Since this is not a limited-capacity model, where T1 is a neutral target and T2 is an emotional target, the production rule can be superseded to process T2 instead of protecting T1 consolidation. Hence, T1 identification becomes impaired because it cannot be processed until T2 has finished processing.

Summary of the AB theories

The Gating Theory claims that an AB occurs because whilst T1 is being processed, T2 is inhibited due to the closing of an attentional ‘gate’. The Interference Theory states that all stimuli have perceptual representations that are registered in visual working memory when they resemble a selection template. An AB occurs because other RSVP stream items in the working memory interfere and reduce the accuracy of T2 reporting. The Two-Stage Model proposes that two stages of processing are required for target reporting. An AB occurs due to the limited-capacity of Stage 2, whereby T2 cannot be processed until the processing of T1 has been completed. The Overinvestment Hypothesis suggests that when too many attentional resources are allocated to the RSVP stream, both targets and distractors receive attention. This causes T2 accuracy to be reduced because of the overwhelming intake of information after T1. The TLC hypothesis states that the AB occurs when targets are from different categories. This causes a disruption in configuration of the input filter and T2 to be processed inefficiently, resulting in an AB. The Boost and Bounce Theory suggests that the enhancement of relevant information (T1) creates a strong inhibitory feedback response that leads to T2 being blocked and producing an AB. The Threaded Cognition model promotes that cognitive modules operate in parallel, however, a single module can only be used for a single task. These theories would have the potential to account for the AB results that I expect to find in Study 3.

AB and Emotional Faces

Research has examined the influence of emotion on increases or decreases in the AB, as well as the differences of this influence in various populations. Most studies have found that emotional targets have greater attentional capture than neutral targets (e.g. Arend & Botella, 2002; Keil & Ihssen, 2004). However, the results of studies examining which emotions capture attention more effectively (if at all) are much less consistent. As Study 3 investigated the relationship between media multitaskers and attentional biases or deficits towards emotional processing, the literature review will focus on the AB and emotion related stimuli, starting with studies using face stimuli.

Table 8.1 provides an overview of AB studies using emotional face stimuli. In summary, in both non-clinical and various clinical populations, emotional faces are preferentially detected over neutral faces and this increases the AB when T1 is emotional but reduces the AB when presented as T2 (Grynberg et al., 2013; Maratos et al., 2008; Miyazawa & Iwasaki, 2010; Schönenberg & Abdelrahman, 2013; Yerys et al., 2013). For participants with anxiety, Fox et al., (2005) and van Dam et al. (2012) found a reduced AB for high socially anxious participants when T2 was a fearful face compared to when it was a happy face, but the reverse pattern was observed for low anxiety participants (van Dam et al., 2012). In contrast, when angry faces were used as T2, no significant differences were found between low and high anxiety groups (de Jong & Martens, 2007; de Jong et al., 2009). Since state moods have a role on AB task performance, Study 3 controlled for this by using state anxiety and state depression as covariates. The existing research shows that methodology often varies across studies including differences in stimuli used (both T1, T2 and distractors), and task instructions (e.g., detecting targets, identifying what targets are). This may explain the inconsistencies in results across studies. Some studies have specifically investigated the impact of manipulating these types of task differences, and found that they can affect AB performance (Collins, Blacker & Curby, 2013; Műsch, Engel & Schneider, 2012; Stein et al., 2009).

Study 3 compared media multitasking groups on AB performance, which has not been explored before. Based on previous findings with non-clinical populations, it is expected that an AB of a larger magnitude would occur at a shorter SOA (300ms) and reduce or disappear at longer SOAs (500ms) when T1 is emotional and T2 is neutral. If Lag-1 sparing occurs at 100ms SOA, then T2 detection would be unimpaired. When T1 is neutral and T2 is emotional, the AB should be reduced because emotional faces would capture attention more readily than neutral faces. Given that HMM are suggested to have poorer filtering abilities (e.g., Ophir et al., 2009), it is expected that they would have more deficits in detecting and identifying T1 and T2 compared to AMM and LMM. This is because both targets and distractors in the stream are more likely to compete for resources in HMM instead of the distractors being effectively ignored. It is also predicted that because HMM likely have greater exposure to negative stimuli from multiple media forms, their attunement to negative stimuli would be greater. Therefore T2 neutral detection following an angry T1 would be even more impaired, compared to AMM and LMM. However, detection of T2 angry following T1 neutral would be superior for HMM compared to AMM and LMM. On the other hand, detection of happy targets would be better for LMM compared to AMM and HMM.

Table 8.1. *Overview of AB studies using emotional face stimuli.*

Author and year	Sample type	Targets/distractors	Additional procedural information	Main findings
Borton, Oakes & Lengieza (2017)	Healthy participants, also measured type of self-esteem	T1: socially rejecting (disgusted), accepting (smiling), emotionally negative (gruesome) scenes, or neutral (vegetables) T2: rotated landscape or building	Report which way T2 was rotated Before task, participants told to imagine they were giving a speech about themselves to a room full of strangers	Compared to secure self-esteem, those with defensive self-esteem made more errors after a rejecting face at SOA 400ms. Rejecting faces captured attention even better than gruesome scenes for those with defensive self-esteem.
Kang, Ham & Wallraven (2017)	Healthy participants, also measured empathy levels	T1: neutral face T2: happy, sad, or neutral face of self or others Distractors: scrambled faces	Report gender of T1 Reported emotion of T2	Reduced AB when T2 was emotional compared to neutral. High empathy individuals had enhanced detection for sad-others T2 compared to other conditions
Maratos, Mogg & Bradley (2008)	Healthy participants	Targets: threatening, positive, neutral schematic faces	Report number of targets and emotion of second target (if present).	AB reduced when T2 was threatening compared to neutral.
Miyazawa & Iwasaki (2010)	Healthy participants	T1: flower symbols T2: happy, angry, neutral face icons	Identify T1 and T2 (multiple-choice)	T2 happy faces reported more accurately than neutral and angry faces.
Srivastava & Srinivasan (2010)	Healthy participants	T1: happy or sad faces T2: letter L or T	SOA (0-900ms)	T1 happy faces identified better than T1 sad faces, especially at shorter SOAs (0ms and 100ms) T2 identification better than preceded by happy faces compared to sad faces.
Yerys et al. (2013)	Children (8-14 years) with autism, healthy controls	T1: picture of dog T2: angry or neutral face Distractors: scrambled faces		Children with autism showed similar AB magnitudes as typically developing children for both facial expressions.
Grynberg, Vermeulen & Luminet (2013)	Participants with alexithymia	T1: angry, fear, pain faces T2: indoor or outdoor scene Distractors: inverted neutral faces	Identify emotion of T1 and whether T2 was an indoor or outdoor scene	All T1 faces produced an AB for T2. High alexithymia individuals produced larger ABs for fear and angry faces compared to low alexithymia individuals. T1 angry faces only produced AB for T2 at very short SOA (134ms). T1 fear and T1 pain faces produced AB for T2 at both SOAs (134ms and 335ms)

Schönenberg & Abdelrahman (2013)	Victims of torture with PTSD, healthy controls	T1 and T2: angry, happy faces Distractors: neutral faces	Identify T1 and T2 emotion	T2 angry faces reduced the AB T1 angry faces enhanced AB magnitude for T2, but not for the PTSD group
de Jong & Martens (2007)	High and low socially anxious women	T1 and T2: angry, happy faces		T2 happy face identification impaired when T1 was an angry face. AB effect reduced when T1 was a happy face and T2 was an angry face. T2 angry face also hindered T1 happy face identification. No significant difference between high and low socially anxious groups
de Jong et al. (2009)	High and low socially anxious women	T1: letters T2: angry, happy, neutral faces		No enhanced biases for angry faces compared to happy faces. Non-significant trend that socially anxious people had more difficulty accurately identifying expressions
Fox, Russo & Georgiou (2005)	Participants with social anxiety	T1: picture of flowers or mushrooms T2: fear or happy face Distractors: neutral faces	Indicate if emotional face was present in stream	Strong AB for T2 happy faces but reduced AB for T2 fear faces in high socially anxious participants.
van Dam, Earleywin & Altarriba (2012)	High and low general anxiety	T1 and T2: happy, fear, neutral faces Distractors: upside-down neutral faces	Identify T1 and T2 emotions	No difference in T1 detection between groups Low anxiety group better at detecting T1 fear faces when T2 was a neutral face. High anxiety group identified T1 fear faces more accurately than T1 happy faces. Contrasting results for low anxiety group. High anxiety participants showed impaired T2 detection compared to low anxiety participants, regardless of lag position.

AB and Emotional Words

Some studies have explored the effect of emotion words on the AB. Table 8.2 overviews AB studies using emotional word stimuli with various populations. Generally, these studies show that emotionally salient stimuli, including words (e.g. Anderson, 2005; Koster et al., 2009), have an advantage for capturing and maintaining attention (Anderson & Phelps, 2001). Overall, the evidence shows that emotional target words (especially negative) reduce the AB (Anderson, 2005; Keil et al., 2006; Ogawa & Suzuki, 2004; Schwabe & Wolf, 2010). Negative emotional words appear to be superior in reducing the AB compared to positive emotional words (Keil & Ihssen, 2004; Ogawa & Suzuki, 2004). Differences in semantic content between target words and distractors also reduce the AB magnitude because targets are more easily distinguished and identified from distractors (Barnard et al., 2005). Additionally, word arousal levels have been found to influence AB performance (Anderson, 2005; Keil & Ihssen, 2004). Emotional words show greater reduction in the AB in high-trait anxiety individuals (Arend & Botella, 2002), particularly for threat words (Barnard et al., 2005). Both positive and negative emotional words have shown an influence on AB performance across various studies of different populations such as people with anxiety (e.g., Arend & Botella, 2002), people with dysphoria (e.g., Koster et al., 2009), or healthy participants (e.g., Keil et al., 2006). These studies show that where words are more related to an individual's affect or condition, the AB tends to be reduced.

HMM have been suggested to use a bottom-up cognitive processing style while LMM use a top-down cognitive processing style (Ophir et al., 2009). This may mean that even with task instructions to only focus on identifying targets, HMM may still take in the vast number of stimuli presented in the whole stream and therefore be easily distracted by them, or leave themselves with less cognitive resources to process the target information. This would result in poorer target detection compared to AMM and LMM who are more able to focus on the given task. It is expected that HMM would be more attuned to negative words because of constant use and exposure to them through media. Due to this attunement, HMM would have more impaired T2 detection when T1 is an angry word, compared to when T1 is a happy word, and compared to AMM and LMM. However, detection of a T2 angry word when T1 is neutral would be better in HMM compared to AMM and LMM.

Table 8.2. *Overview of AB studies using emotional word stimuli.*

Author and year	Sample type	Targets/distractors	Additional procedural information	Main findings
Keil, Ihssen & Heim (2006)	Healthy participants	T1: neutral verbs T2: pleasant, unpleasant, neutral verbs Distractors: neutral verbs		Reduced AB for reporting emotional T2 compared to neutral T2.
Ogawa & Suzuki (2004)	Healthy participants	T1: neutral *kanji* T2: positive, negative, neutral *kanji* Distractors: neutral *kanji*	Identify T1 and detect presence of T2	Positive words reduced AB more than neutral words. No AB for negative words.
Arend & Botella (2002)	High and low trait anxious	T1: positive, negative, neutral emotional word T2: the neutral word 'theatre' Distractors: neutral words		Emotional T1 reduced AB more in high trait anxious group than low trait anxious group
Barnard et al. (2005)	High and low trait anxious	T1: neutral word (household items) T2: job/profession Distractors: threat words, neutral words from the same and different category to T1	Identify the job	Typical AB when distractors and targets had little similarity in meaning to T2 Threat distractors led to greater impairment of T2 report than neutral distractors for high anxiety group, but only at 440ms SOA.
Koster et al. (2009)	Dysphoric participants, healthy controls	T1: positive, negative, neutral words T2: neutral words		T2 identification more impaired when T1 was a negative word, especially at 228ms SOA. Those with more depressive symptoms produced larger ABs than controls
Anderson (2005)	Healthy participants	Experiment 1 T1: neutral words T2: negative, negative-arousing, neutral words Distractors: longer neutral words Experiment 2 Same as Exp 1, but with positive and positive-arousing words		AB reduced when T2 was an emotional word compared to neutral. Effect further enhanced with arousing words in both the positive and negative conditions
Keil & Ihssen	Healthy participants	T1: neutral verbs T2: pleasant and unpleasant arousing verbs		Better T2 detection when it was an arousing verb, especially unpleasant.

(2004)		Distractors: neutral verbs	Pleasant and unpleasant verbs with low emotional arousal did not show this enhancement.
Schwabe & Wolf (2010)	Healthy participants	Targets: aversive or neutral nouns Distractors: neutral words	AB reduced when T2 was aversive, but only when T1 was neutral.

Method

Participants

Participant demographics and information was outlined in Chapter 5.

The AB task

A face version and a word version were used for the attentional blink task. For each version, there were 15 practice trials and 150 experimental trials with equal number of trials for each SOA. Each target combination had 30 trials, 10 for each SOA (100ms, 300ms, 500ms). Therefore participants could score up to 10 for each condition and for each SOA. Face and word stimuli were the selected target and distractor stimulus set as described in Chapter 4. Target (T1-T2) combinations were happy-neutral, neutral-happy, angry-neutral, neutral-angry, and neutral-neutral. Participants pressed space bar to start each trial. A stream of 12 items appeared at the centre of the screen for 100ms each, with no interval between each item. On the face version, T1 and T2 were upright faces, while distractors were all different neutral upside-down faces. Target faces in the same trial were never of the same person. On the word version, T1 and T2 were in black font, while distractors were in grey font. All words were presented in capital letters. T1 always appeared at least after two distractors (maximum eight) to allow for sufficient masking, and T2 appeared at SOA 100ms, 300ms, or 500ms after T1 was presented. There were always at least two distractors following the appearance of T2. Participants were given instructions on how to distinguish targets from distractors. After each trial, participants were asked to identify the emotion of T1 and T2 by circling their response (either happy, angry, or neutral) on a response sheet. Participants were allowed to start each trial at their own pace, therefore participants took short breaks whenever they needed to. Refer to Figure 8.1 and 8.2 for a sample AB face and word trial, respectively.

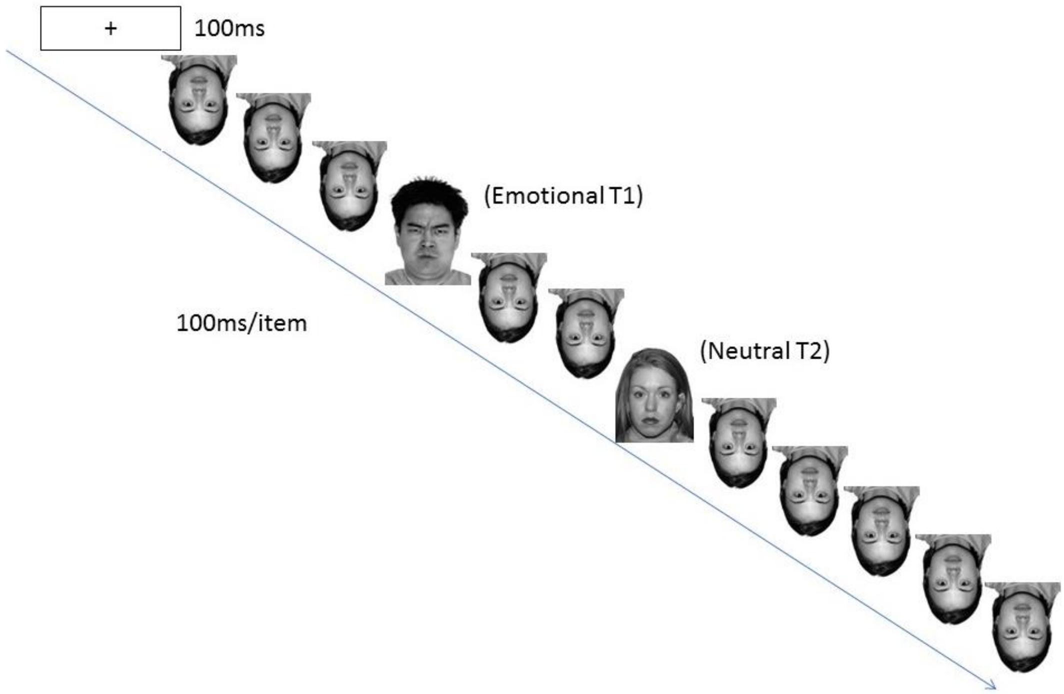


Figure 8.1. Example of an AB face trial (Angry-Neutral 300ms SOA) – Note in the experiment, all distractor faces were different.

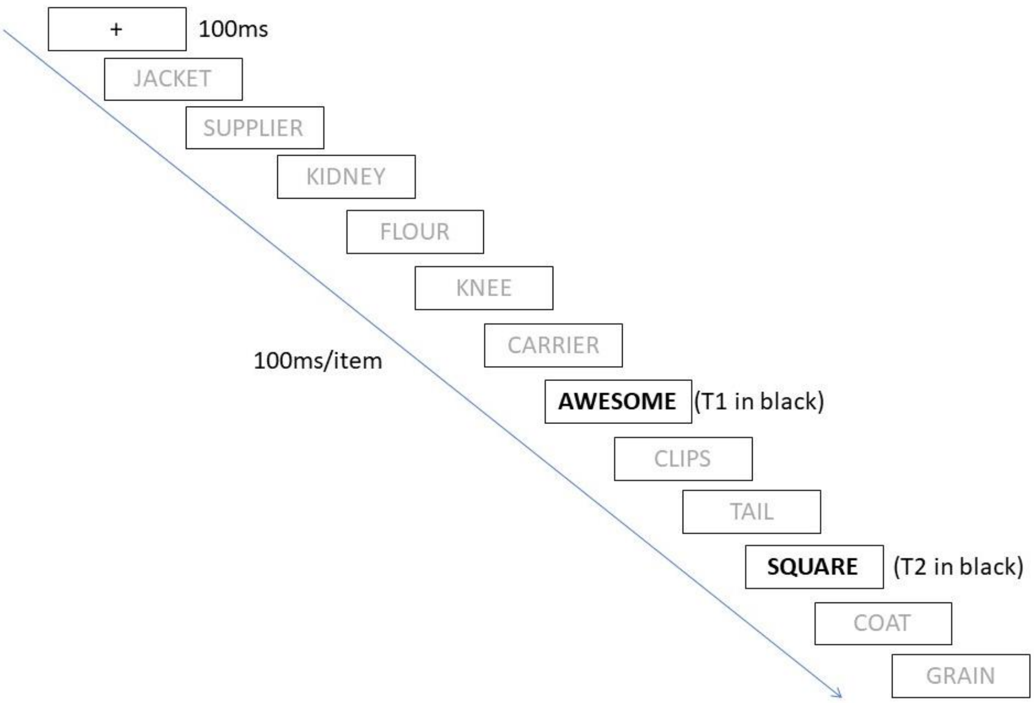


Figure 8.2. Example of an AB word trial (Happy-Neutral 300ms SOA)

Results

Task performance was determined by the number of T1 identified correctly, as well as the number of T2 identified correctly for each condition. The number of T2 identified correctly contingent on when T1 was identified correctly (i.e., the AB effect) was also calculated. A power of 0.56 was obtained using G*Power (Faul et al., 2007) to detect a medium effect size (f = 0.25). A power of 0.94 was obtained to detect a large effect size (f = 0.40). Mixed factorial ANCOVAs were used to analyse the data with state anxiety and state depression as covariates. The between-subjects IV was MMI group (three levels; HMM, AMM, and LMM). The within-subjects IV were target type (two levels; T1 and T2), target combinations (five levels; happy-neutral [H-N], neutral-happy [N-H], angry-neutral [A-N], neutral-angry [N-A], and neutral-neutral [N-N]) and SOA (three levels; 100ms, 300ms and 500ms). The DV was the number of T1 identified correctly, T1 and T2 identified correctly, and the number of T2 identified correctly when T1 was correct. The same analyses were run using trait depression and trait anxiety as covariates instead, as well as without any covariates (refer to Appendix D). There were differences across these analyses, however these differences were not crucial in identifying media multitasking group differences, where the overall pattern of results were similar. Therefore the results using state depression and state anxiety as covariates will be reported here.

AB Face Task

T1 Correct

Results showed that in the AB face task, there were no significant differences between media multitasking groups in identifying T1 correctly, $F(2, 91) = .78$, $p = .46$, partial η^2 = .02. There was no main effect for target combination, $F(2, 194) = 1.85$, $p = .16$, partial η^2 = .02. There was a main effect for SOA, showing that participants performed significantly worse on T1 identification on 100ms SOA (*M* = 6.62, *SE* = .16) trials compared to the 300ms (*M* = 8.88, *SE* = .12) and 500ms SOA (*M* = 8.99, *SE* = .11), $F(1, 136) = 28.54$, $p < .001$, partial $\eta^2 = .24$. There was no significant interaction effects between target combination and group, $F(4, 194) = .70$, $p = .60$, partial $\eta^2 = .02$. There were no interaction effects between SOA and group on T1 identification, $F(3, 136) = .60$, $p = .62$, partial $\eta^2 = .01$. There was a significant interaction effect between target combination and SOA, $F(5, 418) = 3.32$, $p = .01$, partial $\eta^2 = .04$. On all target combinations except the N-N condition, participants performed worse at identifying T1 at 100ms SOA compared to 300ms and 500ms SOA (all *ps* < .05, see Table 8.3). The three-way interaction between target combination, SOA, and group was not significant, $F(9, 418) = .73$, $p = .69$, partial $\eta^2 = .02$.

Table 8.3. *Mean T1 correct and standard errors for interaction between target combination and SOA*

Target Combination	100ms SOA	300ms SOA	500ms SOA
H-N	6.78 (.26)	9.02 (.12)	9.10 (.12)
N-H	5.03 (.29)	8.96 (.16)	8.93 (.18)
A-N	6.87 (.24)	8.60 (.17)	9.18 (.13)
N-A	5.96 (.28)	8.84 (.18)	8.67 (.19)
N-N	8.71 (.15)	8.98 (.15)	9.06 (.13)

T1 and T2 Correct

These analyses of T1 and T2 correct, where scores were not contingent on the other being correct, was conducted to examine differences in performance between groups. While this is not a typical AB analysis, only investigating T2 correct scores when T1 is correct could undermine T2 correct responses, particularly where T1 is neutral and T2 is emotional. Results showed that in the AB face task, there were no significant differences between media multitasking groups, $F(2, 91) = 0.71$, $p = .49$, partial $\eta^2 = .02$. There was a significant main effect for target type where participants identified T1 significantly better than T2, $F(1, 91) = 4.01$, $p = .05$, partial $\eta^2 = .04$. There was a significant main effect for target combination, $F(3, 242) = 2.85$, $p = .04$, partial $\eta^2 = .03$, see Table 8.4. Participants performed better on the N-N condition compared to all other conditions (all *p*s < .03), and on the N-A condition compared to the A-N condition ($p = .01$). However, there were no other significant differences between the other target combinations (all *p*s > .05). There was a main effect for SOA, $F(1, 129) = 32.26$, $p < .001$, partial $\eta^2 = .24$. Participants performed significantly worse on 100ms SOA ($M = 6.16$, $SE = .14$) trials compared to the 300ms ($M = 8.42$, $SE = .12$) and 500ms SOA ($M = 8.80$, $SE = .12$), and worse on the 300ms compared to 500ms SOA (all *p*s < .001).

Table 8.4. *Descriptive statistics (T1 and T2 correct) for target combination*

Target Combination	Mean (SE)
H-N	7.54 (.13)
N-H	7.79 (.16)
A-N	7.37 (.14)
N-A	7.91 (.16)
N-N	8.37 (.12)

There was no significant interaction effects between target type and group, $F(2, 191) = .01$, $p = .99$, partial $\eta^2 = .001$ or target combination and group, $F(5, 242) = .67$, $p = .65$, partial $\eta^2 = .02$. There were no interaction effects between SOA and group, $F(3, 129) = .15$, $p = .92$, partial $\eta^2 = .003$. There was no interaction effect between target type and SOA, $F(2, 148) = .18$, $p = .79$, partial $\eta^2 = .002$, or between target type and target combination, $F(2, 180) = 2.42$, $p = .09$, partial $\eta^2 = .03$. There was no significant interaction effect between target combination and SOA, $F(5, 451) = 1.76$, $p = .12$, partial $\eta^2 = .02$. The interaction between all IVs was also not significant, $F(11, 479) = .96$, $p = .48$, partial $\eta^2 = .003$. Table 8.5 shows the relevant descriptive statistics across target type, target combinations and SOAs.

Table 8.5. *Mean correct responses for each group for target type, SOA and target combination.*

Group	Target	SOA	Condition	Mean (SE)
HMM	T1	100ms	H-N	6.24 (.46)
			N-H	4.76 (.52)
			A-N	6.89 (.43)
			N-A	5.42 (.49)
			N-N	8.75 (.26)
HMM	T1	300ms	H-N	8.90 (.22)
			N-H	9.08 (.28)
			A-N	8.67 (.30)
			N-A	8.78 (.32)
			N-N	8.66 (.26)
HMM	T1	500ms	H-N	8.71 (.21)
			N-H	8.75 (.31)
			A-N	9.21 (.22)
			N-A	8.26 (.34)
			N-N	8.93 (.24)
HMM	T2	100ms	H-N	4.31 (.46)
			N-H	6.24 (.48)
			A-N	4.01 (.45)
			N-A	6.47 (.48)
			N-N	6.52 (.57)
HMM	T2	300ms	H-N	6.84 (.39)
			N-H	8.73 (.36)
			A-N	6.83 (.46)
			N-A	8.70 (.34)
			N-N	7.87 (.32)
HMM	T2	500ms	H-N	7.74 (.36)
			N-H	9.08 (.31)
			A-N	8.00 (.38)
			N-A	8.82 (.28)
			N-N	8.48 (.25)
AMM	T1	100ms	H-N	6.62 (.45)
			N-H	5.06 (.51)
			A-N	6.83 (.42)
			N-A	6.10 (.49)
			N-N	8.64 (.26)
AMM	T1	300ms	H-N	8.97 (.45)
			N-H	5.06 (.51)
			A-N	6.83 (.42)
			N-A	6.10 (.49)
			N-N	8.64 (.26)
AMM	T1	500ms	H-N	8.97 (.22)
			N-H	8.65 (.27)
			A-N	8.45 (.30)
			N-A	8.94 (.32)
			N-N	9.05 (.26)

AMM	T2	100ms	H-N	5.26 (.45)
			N-H	5.96 (.48)
			A-N	4.46 (.44)
			N-A	6.56 (.47)
			N-N	6.37 (.56)
AMM	T2	300ms	H-N	7.32 (.39)
			N-H	8.30 (.36)
			A-N	7.45 (.45)
			N-A	8.31 (.34)
			N-N	8.22 (.31)
AMM	T2	500ms	H-N	8.32 (.36)
			N-H	8.82 (.30)
			A-N	7.93 (.38)
			N-A	8.82 (.28)
			N-N	8.83 (.25)
LMM	T1	100ms	H-N	7.49 (.46)
			N-H	5.27 (.53)
			A-N	6.88 (.44)
			N-A	6.37 (.50)
			N-N	8.73 (.27)
LMM	T1	300ms	H-N	9.20 (.22)
			N-H	9.14 (.28)
			A-N	8.70 (.31)
			N-A	8.81 (.33)
			N-N	9.23 (.27)
LMM	T1	500ms	H-N	9.46 (.22)
			N-H	9.08 (.32)
			A-N	9.35 (.23)
			N-A	8.71 (.34)
			N-N	9.20 (.24)
LMM	T2	100ms	H-N	4.84 (.47)
			N-H	6.55 (.49)
			A-N	4.34 (.46)
			N-A	6.41 (.48)
			N-N	6.48 (.58)
LMM	T2	300ms	H-N	7.82 (.40)
			N-H	8.47 (.37)
			A-N	7.10 (.46)
			N-A	8.77 (.35)
			N-N	8.66 (.33)
LMM	T2	500ms	H-N	8.47 (.37)
			N-H	9.29 (.31)
			A-N	8.54 (.39)
			N-A	9.05 (.29)
			N-N	8.94 (.26)

T2 Correct When T1 Correct

There were no significant group differences on correct T2 identification when T1 was identified correctly, $F(2, 91) = .57$, $p = .57$. There was a significant main effect for SOA, $F(1, 131) = 23.01$, $p < .001$, partial $\eta^2 = .20$. Participants performed worse at 100ms SOA ($M = 4.62$, $SE = .20$), followed by 300ms ($M = 7.51$, $SE = .19$) then 500ms ($M = 8.05$, $SE = .18$, all $ps < .001$). There was a significant main effect for target combination, $F(3, 281) = 3.78$, $p = .01$, partial $\eta^2 = .04$. Further analyses showed that when T1 was an emotional face and T2 neutral (H-N and A-N), T2 identification was significantly worse than when T1 was a neutral face and T2 either emotional or neutral (N-H, N-A, N-N), all $ps < .001$. However, there was no difference between T2 neutral identification when T1 was a happy face and when T1 was an angry face ($p = .63$). Table 8.6 outlines the relevant descriptive statistics. There was no significant interaction between SOA and group, $F(3, 131) = .24$, $p = .86$, partial $\eta^2 = .01$. There was no significant interaction effect between target combination and SOA, $F(6, 511) = .66$, $p = .67$, partial $\eta^2 = .01$, or target combination and group, F $(6, 281) = .60$, $p = .74$, partial $\eta^2 = .01$. The three-way interaction between target combination, SOA, and group was also not significant, $F(11, 511) = .67$, $p = .77$, partial $\eta^2 = .02$.

Table 8.6. *Descriptive statistics for each target combination (T2 correct when T1 correct)*

Target Combination	Mean (SE)
H-N	6.21 (.19)
N-H	7.06 (.21)
A-N	5.98 (.21)
N-A	7.07 (.22)
N-N	7.29 (.18)

AB Word Task

T1 Correct.

Results showed that in the AB word task, there were no significant differences between media multitasking groups in correct T1 identification, $F(2, 91) = .32$, $p = .73$, partial $\eta^2 = .01$. There was no significant main effect for target combination, $F(3, 264) = 1.25$, $p = .29$, partial $\eta^2 = .01$. There was no main effect for SOA, $F(1, 122) = 2.67$, $p = .09$, partial $\eta^2 = .03$. There was no significant interaction effects between target combination and group, $F(6, 267) = .62$, $p = .71$, partial $\eta^2 = .01$. There were no interaction effects between SOA and group on T1 identification, $F(3, 122) = .50$, $p = .66$, partial $\eta^2 = .01$. There was no significant interaction effect between target combination and SOA, $F(6, 580) = .99$, $p = .43$, partial $\eta^2 = .01$. The three-way interaction between target combination, SOA, and group was also not significant, $F(13, 580) = .85$, $p = .60$, partial $\eta^2 = .02$.

T1 and T2 Correct

Results showed that in the AB word task, there were no significant differences between media multitasking groups, $F(2, 91) = 1.15$, $p = .32$, partial $\eta^2 = .03$. There was no significant main effect for target type, $F(1, 91) = .88$, $p = .35$, partial $\eta^2 = .01$. There was no significant main effect for target combination, $F(4, 334) = 1.03$, $p = .39$, partial $\eta^2 = .01$. There was also no main effect for SOA, $F(1, 114) = 2.48$, $p = .11$, partial $\eta^2 = .03$.

There was no significant interaction effects between target type and group, $F(2, 191) = .22$, $p = .80$, partial $\eta^2 = .01$ or target combination and group, $F(7, 334) = .58$, $p = .78$, partial $\eta^2 = .01$. There were no interaction effects between SOA and group, $F(3, 114) = .29$, $p = .80$, partial $\eta^2 = .01$. There was no interaction effect between target type and SOA, $F(2, 145) = .23$, $p = .74$, partial $\eta^2 = .003$, or between target type and target combination, $F(3, 244) = 1.22$, $p = .30$, partial $\eta^2 = .01$. There was no significant interaction effect between target combination and SOA, $F(6, 550) = 1.36$, $p = .23$, partial $\eta^2 = .02$. The interaction between all IVs was also not significant, $F(11, 520) = 1.10$, $p = .36$, partial $\eta^2 = .02$. Table 8.7 shows descriptive statistics for each group across target type, target combinations and SOAs.

Table 8.7. *Mean correct responses for each group for target type, SOA and target combination.*

Group	Target	SOA	Condition	Mean (SE)
HMM	T1	100ms	H-N	9.37 (.23)
			N-H	9.22 (.18)
			A-N	9.03 (.23)
			N-A	9.41 (.14)
			N-N	9.24 (.15)
HMM	T1	300ms	H-N	9.70 (.11)
			N-H	9.73 (.08)
			A-N	9.31 (.19)
			N-A	9.81 (.08)
			N-N	9.87 (.06)
HMM	T1	500ms	H-N	9.56 (.12)
			N-H	9.74 (.19)
			A-N	9.17 (.19)
			N-A	9.79 (.09)
			N-N	9.78 (.06)
HMM	T2	100ms	H-N	8.17 (.33)
			N-H	8.40 (.29)
			A-N	8.00 (.31)
			N-A	8.07 (.36)
			N-N	8.39 (.32)
HMM	T2	300ms	H-N	9.49 (.19)
			N-H	9.41 (.18)
			A-N	9.42 (.16)
			N-A	8.97 (.23)
			N-N	9.76 (.11)
HMM	T2	500ms	H-N	9.68 (.08)
			N-H	9.57 (.13)
			A-N	9.57 (.12)
			N-A	9.13 (.21)
			N-N	9.72 (.08)
AMM	T1	100ms	H-N	9.29 (.23)
			N-H	9.26 (.18)
			A-N	9.05 (.22)
			N-A	9.50 (.13)
			N-N	9.71 (.14)
AMM	T1	300ms	H-N	9.66 (.11)
			N-H	9.84 (.07)
			A-N	9.46 (.18)
			N-A	9.75 (.08)
			N-N	9.84 (.06)
AMM	T1	500ms	H-N	9.69 (.12)

			N-H	9.80 (.08)
			A-N	9.63 (.18)
			N-A	9.89 (.09)
			N-N	9.89 (.06)
AMM	T2	100ms	H-N	8.38 (.32)
			N-H	8.80 (.28)
			A-N	8.15 (.31)
			N-A	7.92 (.35)
			N-N	8.34 (.32)
AMM	T2	300ms	H-N	9.60 (.18)
			N-H	9.36 (.18)
			A-N	9.36 (.15)
			N-A	9.03 (.23)
			N-N	9.59 (.11)
AMM	T2	500ms	H-N	9.78 (.08)
			N-H	9.49 (.12)
			A-N	9.74 (.11)
			N-A	9.00 (.21)
			N-N	9.81 (.08)
LMM	T1	100ms	H-N	9.53 (.23)
			N-H	9.34 (.18)
			A-N	9.29 (.23)
			N-A	9.62 (.14)
			N-N	9.89 (.15)
LMM	T1	300ms	H-N	9.86 (.11)
			N-H	9.97 (.08)
			A-N	9.72 (.19)
			N-A	9.91 (.08)
			N-N	9.98 (.06)
LMM	T1	500ms	H-N	9.78 (.12)
			N-H	9.99 (.09)
			A-N	9.76 (.19)
			N-A	9.85 (.09)
			N-N	9.96 (.06)
LMM	T2	100ms	H-N	8.70 (.33)
			N-H	8.58 (.29)
			A-N	8.54 (.32)
			N-A	7.74 (.37)
			N-N	8.81 (.33)
LMM	T2	300ms	H-N	9.61 (.19)
			N-H	9.39 (.18)
			A-N	9.65 (.16)
			N-A	9.06 (.24)
			N-N	9.70 (.11)
LMM	T2	500ms	H-N	9.91 (.08)
			N-H	9.85 (.13)
			A-N	9.79 (.12)
			N-A	9.27 (.22)
			N-N	9.84 (.09)

T2 Correct When T1 Correct.

There were no significant group differences on correct T2 identification when T1 was identified correctly, $F(2, 91) = 1.09$, $p = .34$. There was no significant main effect for SOA, $F(1, 118) = 1.41$, $p = .24$, partial $\eta^2 = .02$. There was no significant main effect for target combination, $F(3, 318) = 1.04$, $p = .38$, partial $\eta^2 = .01$. There was no significant interaction between SOA and group, $F(3, 118) = .39$, $p = .73$, partial $\eta^2 = .01$. There was no significant interaction effect between target combination and SOA, $F(6, 516) = 1.71$, $p = .12$, partial $\eta^2 = .02$, or target combination and group, $F(7, 318) = .71$, $p = .66$, partial $\eta^2 = .02$. The three-way interaction between target combination, SOA, and group was also not significant, $F(11, 516) = .77$, $p = .67$, partial $\eta^2 = .02$.

Discussion

AB tasks using face and word stimuli were used in Study 3 to examine differences in AB task performance between media multitaskers. Given state anxiety and state depression have been suggested to influence bias over detection of certain emotions on an AB task (e.g. Arend & Botella, 2002; Keil & Ihssen, 2004), these were used as control variables. Findings demonstrated some expected AB effects on the face task such as improved performance at longer SOAs across all groups, but this was not found on the word task. Although there was a main effect for SOA on the face task, Lag-1 sparing was not observed because at 100ms SOA, participants did not show unimpaired T2 detection. According to Hommel and Akyürek, (2005) and Visser et al., (1999), lag-1 sparing can fail to occur because of the two targets being similar in strength, and therefore participants could lose information about their temporal order even if both targets get access to attentional resources. This would lead to participants identifying targets incorrectly if they answered them in the wrong order (e.g., responding as N-H when the correct answer is H-N would result in a score of 0). This may also indicate that there may be some inconsistencies in the occurrence of Lag-1 sparing, which could be dependent on other factors such as type of stimuli used, task difficulty, or task instructions.

On both the face and word tasks, no significant group differences were found between HMM, AMM, and LMM across target combinations and SOA. These results did not support the hypothesis that HMM would perform worse than AMM and LMM in target detection. The results also did not provide evidence that HMM had greater impairment in detecting a target when the other target was an angry emotion compared to AMM and LMM.

Partially consistent with previous literature (Choisdealbha et al., 2017; Maratos et al., 2008; Miyazawa & Iwasaki, 2010), the AB was reduced when T2 was an emotional face. According to the Two-Stage Processing Model (Chun & Potter, 1995; Hommel & Akyürek, 2005), the stronger target is more likely to win attentional resources at the expense of the competitor. However, if both targets are equally strong categorically, they are likely to become integrated into the same cognitive episode. This could explain why the target identification performance was better in the N-N condition than other conditions in the face task. Alternatively, subtle facial expressions might require more time to determine the emotion as it does not pop-out the way a more exaggerated facial expression would. Therefore, participants may default to identifying targets as neutral when the emotion has been “missed”. This would result in higher scores for correct identification of neutral targets and lower scores in identification of emotional targets. If this is the case, then these results may not be a reliable indication of emotion processing on an AB task. Either more exaggerated facial expressions would need to be used, or one of the targets could be a non-face stimuli such as landscape or animal pictures, as other studies have used (e.g., Borton et al., 2017; Yerys et al., 2013).

Previous research has shown that in clinical populations (i.e., participants with general anxiety, social anxiety, depression), attentional biases emerged for faces or words that were consistent with the symptoms of their clinical condition (Fox et al., 2005; Schönenberg & Abdelrahman, 2013; van Dam et al., 2012). These studies support the notion that a condition can influence people's attentional biases towards specific types of information, therefore increasing their attunement or efficiency at identifying it, which then maintains that condition. In media multitaskers, it was expected that high levels of exposure to media likely containing negative information would increase attunement of HMM to negative faces and words. The findings did not support this hypothesis, although partcipants' overall AB was reduced when an emotional face appeared at T2 compared to when a neutral face appeared at T2. However, this effect was not extended to words. This could suggest that while the word task may have been too easy, it could also perhaps be in part due to the increasing use and exposure to negative words, that people have generally become more resistant or used to them. This means that the salience of angry words becomes reduced, they are less likely to be perceived as threatening, and therefore are not processed as efficiently as other threatening information. On the other hand, the same may have occurred for the increasing trend of positive living being advertised frequently in social media, which would also increase exposure to positive words. Still, there is some evidence for attentional bias towards emotional faces over neutral faces, which is consistent with existing literature (Borton et al., 2017; Grynberg et al., 2013; Kang et al., 2017), although in this case it may have been minimised due to the subtle expressions used.

No previous study has investigated differences in emotion processing on an AB task in media multitasking groups before. Previous research that have studied other types of cognitive ability (e.g., Cardoso-Leite et al., 2016; Ophir et al., 2009; Ralph & Smilek, 2017) led to the hypothesis that HMM would perform more poorly on this task than AMM and

LMM, especially due to their poor filtering and inhibition abilities. However, this was not the case. One explanation for this lack of difference could be that the task was too difficult for the processing of subtle facial expressions because of the extremely short presentation time of each item, as well as between targets. This means that even if the targets have been identified amongst distractors (upright versus upside-down), the features of the face only have enough time to be processed poorly therefore it is difficult to accurately determine its emotion. On the other hand, the lack of difference on the AB word task could be because people are used to reading words in quick succession of each other. Words have less features to process than faces, and therefore have the potential to be processed more quickly, hence allowing T2 to also be processed even at shorter SOAs. Therefore, while the face task may have been too difficult, and the word task too easy, participants overall performed equally poorly or well. Perhaps at these levels of difficulty, ability to filter distractors is less influential than what was expected.

In summary, Study 3 conducted an AB face and an AB word task to investigate differences between media multitasking groups. While no group differences were found across SOA or target combination in both tasks, several findings indicating attentional biases for participants overall were described. These include a general bias for emotional faces that was not extended to emotional words. As expected, overall performance was worse at a shorter SOA (300ms) and improved at a longer SOA (500ms) on the face task. Lag-1 sparing did not occur, and target identification was actually worse at 100ms SOA compared to 300ms SOA. However, contrary to what was expected, these performance deficits at shorter SOAs were not observed in the word task. Although task stimuli and difficulty should be taken into account as previously explained, these results could suggest that more research needs to be done to determine whether higher levels of media multitasking actually impair emotional target identification performance on an AB task. Further research with improved task design needs to be done to provide further knowledge in this area. The following chapter provides a summary and general discussion of the studies and findings of this thesis, including its limitations and directions for future research.

CHAPTER 9: CONCLUSIONS

The present research examined the psychosocial well-being, personality traits and emotion processing of media multitaskers. The main goal was to provide insight into the potential contribution of media multitasking behaviours on these outcomes. This chapter will outline the research questions and findings for each study, and tie together an overall conclusion for the research presented in this thesis. I will discuss the implications of the current research as well as the limitations and directions for future research.

To revisit the overview of the current research and to discuss how each research question was addressed, I refer to Figure 9.1, which was also presented in Chapter 1. To attempt answering these research questions, two surveys and one experimental study (with three different experimental tasks) was employed. Study 1 involved the use of a media multitasking questionnaire, and psychosocial measures to assess trait depression, trait anxiety, social anxiety, empathy, general well-being, and personality measures (Big 5 and narcissism). Study 2 was a stimuli selection process including a word rating study needed to produce a word list that could be used in Study 3 along with faces selected from the NimStim Face Stimulus Set (Tottenham et al., 2009). Study 3 involved the use of emotional face and word stimuli on three well-established attention tasks – the dot probe task, the visual search task, and the AB task. These were conducted with participants who were grouped as HMM, AMM, and LMM based on their MMI scores.

Psychosocial Outcomes and Emotion Processing in Media Multitaskers

Study 1
(Chapter 2 and 3)
Purpose: To explore relationships between media multitasking, psychosocial well-being, and personality characteristics
Sample: First year undergraduate students
Task: Online survey
Measures: MMI, MTSD-T, STAI-T, IAS, WBMMS, TEQ, BFI-10, NPI-16
Analysis: Correlational, regression and mediation analyses

Study 2
(Chapter 4)
Purpose: To rate and select emotional face and word stimuli for Study 3
Sample: First year undergraduate students
Analysis: One way ANOVA

Study 3
(Chapter 6, 7, and 8)
Purpose: To examine emotion processing in media multitaskers through attentional tasks
Sample: Volunteer participants who engage in light, average, or heavy media multitasking
Tasks: Dot-probe, visual search, attentional blink
Measures: MMI, MTSD, STAI,
Analysis: Mixed Factorial ANCOVA

Research Question 1: Is media multitasking associated to poorer psychosocial outcomes such as depression, anxiety, empathy, and general well-being?

Research Question 2: Does media multitasking relate to personality characteristics, and does media multitasking mediate the relationship between personality and psychosocial outcomes?

Research Question 3: Are there negative psychosocial outcomes for media use during face-to-face interaction, and does this behaviour contribute to poorer psychosocial outcomes after controlling for personality variables?

Research Question 4: Do heavy media multitaskers perform worse on attention tasks compared to light and average media multitaskers?

Research Question 5: Do different groups of media multitaskers have attentional biases towards specific emotions?

Research Question 6: Are these group differences, if any, consistent across three established attention tasks?

Figure 9.1. Overview of the three empirical studies and the research questions addressed in each.

Research Question 1: Is Media Multitasking Associated to Poorer Psychosocial Outcomes such as Depression, Anxiety, Empathy, and General Well-Being?

Expanding on the work of Becker et al. (2013), Study 1 investigated the relationship between media multitasking and psychosocial outcomes such as trait depression, trait anxiety, social anxiety empathy, and general well-being. As Becker et al. (2013) had only used a state depression and social anxiety measure in their study, the present research provides further insight into the potential of a multitude of psychosocial outcomes associated with media multitasking behaviours.

The findings from Study 1 showed that higher levels of media multitasking were associated with higher levels of trait depression, higher trait anxiety, poor sociability (a component of general well-being, and lower levels of empathy). In contrast to Becker et al. (2013), social anxiety was not significantly associated with media multitasking behaviours. Overall general well-being was also not significantly associated with media multitasking behaviours, which is inconsistent with previous media multitasking studies (e.g., Pea et al., 2012, Xu et al., 2016). This may be due to different well-being measures used, such as those assessing life satisfaction, social success or feelings of normalcy (e.g., Pea et al., 2012; Xu et al., 2016). It could also be due to the different combination of media activities that comprised high levels of media multitasking in this sample compared to others from previous studies. If some types of media multitasking activities (e.g., offline computer tasks) are conducive to well-being in an adult's environment (but not necessarily for children), then high levels of these activities may balance out the general well-being outcomes of those who have high levels of media multitasking activities that may be more detrimental to general well-being.

Following Becker et al., (2013), when total media use, extraversion, and neuroticism was controlled, media multitasking still predicted trait depression, trait anxiety, and empathy.

Expanding on this, I controlled for total media use and all Big 5 personality traits. The findings were consistent in that media multitasking continued to predict trait depression, trait anxiety, and empathy. This demonstrates the potential for media multitasking behaviours to contribute to these psychosocial outcomes that have not previously been investigated. Consistent with previous research and some predictions of this research, the current research shows an association between media multitasking and poorer psychosocial outcomes. Given the increasing prevalence of media multitasking behaviours amongst society, this could contribute to higher risks of mental health issues in people.

Research Question 2: Does Media Multitasking Relate to Personality Characteristics, and Does Media Multitasking Mediate the Relationship Between Personality and Psychosocial Outcomes?

In Study 1, higher levels of media multitasking were found to be related to lower levels of agreeableness, conscientiousness, and openness, and to higher levels of narcissism. In contrast to Becker et al. (2013), the results did not show a significant relationship with extraversion and neuroticism.

Media multitasking was found to partially mediate the relationship between personality traits (agreeableness, conscientiousness, openness, and narcissism) and psychosocial outcomes (trait depression, trait anxiety, empathy, and sociability). This means that personality influences media multitasking behaviour, which in turn, influences psychosocial outcomes. However, since the relationship is only partially mediated, it would mean that media multitasking does not fully explain the relationship between personality and psychosocial outcomes, which is to be expected given many other variables (e.g., socioeconomic status, relationships with others) can contribute to the explanation of this relationship (Noftle & Shaver, 2006; Roberts et al., 2007). Media multitasking partially mediated the relationship between conscientiousness, agreeableness, openness, narcissism, and trait depression. The same was found between those personality traits and empathy. Media multitasking also partially mediated the relationship between agreeableness, narcissism, and trait anxiety. In addition, media multitasking partially mediated the relationship between conscientiousness, agreeableness, openness, and sociability.

This was a novel study attempting to connect the link between personality, media multitasking, and psychosocial outcomes. Taking the results together, it is suggested that, in line with the Big 5 theory of personality, enduring personality traits influence the likelihood of a person engaging in certain behaviours such as media multitasking. Higher levels of media multitasking would then influence one's psychosocial well-being. This could be due to increased exposure to negative media (Trussler & Soroka, 2014), potential for cyberbullying, or even just a reduction in quality social interaction (McDaniel & Coyne, 2016; Misra et al., 2016). Indeed, the associations found between media multitasking and empathy allude to media multitasking contributing to either a lack of development of empathic skills through reduced opportunity for social interaction (Uhls et al., 2014), or that the interaction through media comes with a certain barrier between an individual and others. This is commonly seen in internet "trolls" and "keyboard warriors" who attack others online in a way that they are unlikely to face-to-face (Dooley, Pyzalski & Cross, 2009). Findings from Study 1 provide support that media multitasking is related to personality traits (e.g., Duff et al., 2014; Jeong & Fishbein, 2007; Sanbonmatsu et al., 2013), and also shows that media multitasking partially mediates the relationship between personality traits and psychosocial outcomes.

Research Question 3: Are there Negative Psychosocial Outcomes for Media Use During Face-to-Face Interaction, and Does this Behaviour Contribute to Poorer Psychosocial Outcomes After Controlling for Personality Variables?

The current research investigated media multitasking based on both definitions commonly used in the literature (i.e., using more than one media concurrently, or using media with a non-media activity). This research question was investigated using the latter definition by exploring the relationship between media use during face-to-face interaction and psychosocial outcomes was also explored. Firstly, results from Study 1 showed that face-to-face interaction was associated with all psychosocial measures used. Consistent with previous research showing a positive relationship between social interaction and well-being (Lyubomirsky et al., 2005; Reis et al., 2000; Uchino, Cacioppo & Kiecolt-Glaser, 1996), higher amounts of face-to-face interaction were related to lower trait depression, trait anxiety, social anxiety, but higher empathy, general well-being and all its subscales. However, higher levels of media use while interacting face-to-face were related to higher trait depression, trait anxiety, social anxiety but lower empathy, general well-being, happiness, mental balance, and sociability.

The reversal of these associations (from positive to negative or from negative to positive) suggests that using media while interacting with others is linked to poor psychosocial well-being. According to the Threaded Cognition Theory (Salvucci & Taatgen, 2008) of multitasking, an individual processes information by allocating cognitive modules that are needed to process that information. However, each type of module can only be used for one thing at a time. Following this theory, trying to use media while interacting with others would often require the same cognitive module (e.g., visual and/or auditory), therefore both cannot be done effectively. As a result, it is interpreted that using media while interacting face-to-face likely reduces the quality of social interaction, leading to poorer quality and satisfaction of relationships, less feelings of connectedness, and reduce opportunities for developing empathic skills. Previous research has established that these relationship factors are robustly related to negative well-being outcomes (McDaniel &

Coyne, 2016; Misra et al., 2016; Przybylski & Weinstein, 2013; Uhls et al., 2014), which would be supportive of the current findings.

Further, the results from Study 1 also provided insight that different types of media activities may influence these psychosocial outcomes differently. For example, using social media while interacting with others was related to higher depression and anxiety symptoms. However, doing a media activity that may be isolating and mundane (e.g., offline computer tasks) while interacting with others was instead related to lower trait anxiety and social anxiety. Although causal conclusions cannot be made through the present research, it provides evidence that consideration of the type of media multitasking activities is needed in future studies.

The current research shows that using media while interacting face-to-face is linked with poorer psychosocial well-being. Given this is an increasingly prevalent behaviour amongst children and adults, it is important to identify these links so that the implementation of media multitasking at home, schools, or workplaces can be reduced where possible. People who are at higher risk of poor well-being because they frequently engage in using media while interacting with others can also be made more aware of the implications and seek help or preventative measures to bolster their own well-being.

Study 2 – Stimuli Selection

Study 2 was conducted to select appropriate stimuli for use on the attention tasks in Study 3. This involved the selection of face stimuli from an established database – the NimStim Face Stimulus Set (Tottenham et al., 2009) and a word rating study. The purpose of this study was to ensure the suitability of faces and words used, and to ensure that the words defined the emotions, happy and angry. The final sets of happy, angry, and neutral target words used for Study 3 were matched across agreement rating, intensity rating, word frequency, and orthographic neighbourhood size. A pool of neutral distractor words was also generated.

Research Question 4: Do Heavy Media Multitaskers Perform Worse on Attention Tasks Compared to Light and Average Media Multitaskers?

This research question was examined through the experimental tasks employed in Study 3. Attention tasks (dot-probe, visual search, and AB) were used as measures of selective, spatial, and temporal attention, respectively.

Contrary to the hypotheses, Study 3 found that HMM did not perform worse than AMM and LMM on any of the three attention tasks (dot-probe, visual search, and AB). Only one previous study has explored emotion processing on attention tasks in media multitaskers (Shukla, 2016), and this study used only the dot-probe task with face stimuli. Nevertheless, the results from the present research contrasts the results from Shukla's (2016) experiment, which found that HMM performed more poorly than LMM. It is suggested that this inconsistency could partly be attributed to the subtle faces used in Study 3, which was not salient enough to elicit significant attentional bias differences between groups (emotional biases addressed in the next section). Similarly, on the visual search task, there were no group differences across face and word tasks, or array sizes. On this task, it was proposed that the lack of differences may be due to the different search strategies employed by HMM, AMM, and LMM, combined with poor inhibition and distractor filtering in HMM (e.g., Ophir et al., 2009), that has perhaps balanced out their performances. However, the error rates for emotion-present face trials were higher than emotion-absent face trials (but not on the word task), which supports that the subtle facial expressions were more difficult to identify as they look similar to the neutral distractors. On the AB task, there were also no group differences across face and word tasks, SOA, or target combination. It is likely that the processing of subtle expressions was too difficult at such rapid presentation times, given participants had to process the faces both categorically and featurally to determine a target and its emotion. On the other hand, words are typically read in rapid succession of each other and do not have to be processed in a featural way like faces do. Hence, the AB face task may have been too difficult, while the AB word task may have been too easy. As a result, the groups performed equally poorly and equally well on the AB task.

Despite the lack of group differences, the results of each task were still consistent with some of the relevant theories. For the dot-probe task, the results could be accounted for by the Cognitive Motivational Analysis model (Mogg & Bradley, 1998) in that the goal engagement system leads to the allocation of resources to that goal. In this situation, there was no need for interruption from the valence evaluation system because there was no significant threat present. The visual search task was best explained by a combination of the Attentional Engagement Theory (Duncan & Humphreys, 1989) and Signal Detection Theory (Getty et al., 1979). Respectively, they suggest that there is an increase in the likelihood of participants overlooking emotional targets because they look similar to the neutral distractors, and that the input of all stimuli in the visual search occurs at the same time, where differences in variances between stimuli determine discriminability and identification. This accounts for the high error rate on emotion-present trials compared to emotion-absent trials, but also explains why search time was faster on emotion-present trials compared to emotion-absent (all neutral) trials. To exclude a speed-accuracy trade off, the IES was calculated and showed a similar pattern of results. On the AB task, the lack of significant difference between groups and across conditions could be explained by the Two-Stage Processing Model (Chan & Potter, 1995; Hommel & Akyürek, 2005), which states that the stronger target (in this case, more emotionally salient target) is more likely to win attentional resources at the expense of the competitor. However, if both targets are equally strong categorically, they are likely to become integrated into the same cognitive episode and enhance detection, as observed in the N-N condition.

In conclusion, HMM did not perform worse (or better) than AMM and LMM on the attention tasks. These results do not support the hypotheses of the present research, but is the first to provide experimental results on media multitaskers' performance on a range of attention task performance using emotional stimuli.

Research Question 5: Do Different Groups of Media Multitaskers Have Attentional Biases Towards Specific Emotions?

I hypothesised that HMM would be more biased than AMM and LMM towards angry emotions compared to happy and neutral emotions. Study 3 findings did not support the hypothesis. However, within the HMM group, participants were more fixated on happy faces, as observed in the happy-Pneutral condition relative to the neutral-Pneutral condition, which is somewhat consistent with Shukla (2016) who found that HMM were more biased towards happy faces.

On the visual search and AB tasks, there were no group differences on attentional biases towards specific emotions. However, participants overall were more biased towards happy words than angry words on the visual search task. Participants were also better at identifying happy and angry faces on the AB face task compared to neutral faces, but not as good as identifying angry words on the AB word task compared to happy words. Taken together, it is suggested that perhaps people in general have become more desensitised to negative words as they have become more commonly and aggressively used in society, particularly through media forms. Alternatively, the word task may have been too easy.

Consistent with previous emotional attention task studies, the current findings provide some support that emotional stimuli capture attention more readily than neutral stimuli. There was also some evidence to show that in general, media multitasking groups do not appear to have attentional biases towards specific emotions, but this could have been influenced by stimuli and task difficulty.

Research Question 6: Are These Group Differences, if any, Consistent Across Three Established Attention Tasks?

There were no consistent group differences found on attention task performance across the three established tasks used to assess selective attention, spatial attention, and temporal attention. Instead, what was found to be consistent was that participants overall were more biased towards emotional stimuli compared to neutral stimuli, and this was evident across the three tasks. There were some inconsistencies between the face and word task, where there was a weaker bias towards negative words compared to happy words in the visual search and AB word tasks, but was not observed for faces.

Implications, Limitations and Future Research

The current research contributes to a better understanding of how media multitasking behaviours might or might not influence psychosocial well-being and emotion processing. Media multitasking has two commonly used definitions. Firstly, media multitasking can be defined as the concurrent use of more than one media form (Ophir et al., 2009). Alternatively, media multitasking can also be defined as the use of media while engaging in a non-media activity (Xu et al., 2016). Exploring both definitions, Study 1 demonstrates that both are associated with negative psychosocial outcomes. This has implications for home life and educational/workplace settings. For example, the increasing presence of technology in educational settings plus the individual's own access to technology (e.g., phones, tablets, laptops) means that media multitasking becomes difficult to avoid. This may reduce opportunities for building stronger peer relationships as the focus remains on media use rather than social interaction with others. Media multitasking may also reduce learning or job efficacy (Fox, Rosen & Crawford, 2009; Garrett & Danziger, 2008) and academic success (Jacobsen & Forste, 2011) for several reasons such as distractibility through accessing media unrelated to the subject/job (e.g., browsing Facebook, playing phone games), increased stress (Reinecke et al., 2016), or even fear of missing out (Alt, 2015). In home life, more media multitasking would likely lead to less social interaction and poorer quality interaction (McDaniel & Coyne, 2016; Przybylski & Weinstein, 2013). This would ultimately contribute to lower relationship satisfaction and less feelings of connectedness. Even in children, media multitasking could potentially contribute to an increased predisposition for depression and anxiety, reduced opportunities for development of empathy and other social skills.

Nevertheless, the current research only provides correlational findings, and not causal findings. While I have attempted to draw links between the relationship between media multitasking, personality, and well-being, this was explored in the direction where media multitasking was identified as a possible mediator between personality and well-being based on majority of the existing literature. It remains unknown whether a change in direction with well-being or personality being the mediator would also produce any significant results and could be an interesting avenue for future research.

On the other hand, the current research also provided evidence that media multitasking is not strongly linked with the emotion processing of faces and words on attention tasks, or at least for subtle facial expressions. Only on the dot-probe task did HMM appear more fixated on happy faces. This indicates that perhaps media multitasking behaviour is not bad in all aspects. Future research could aim to investigate whether the same results emerge when more exaggerated emotional faces are used. These facial expressions could show more obvious emotion such as smiling with teeth, anger with gritted teeth and a more noticeable frown. Nevertheless, it should be noted that in this experiment, state depression and anxiety were both controlled for. Given the potential implications higher levels of media multitasking has on trait depression and anxiety scores, HMM would have an increased vulnerability to having higher state depression and anxiety scores. If these were severe enough, then previous research on clinical populations indicates that there would be more attentional biases towards negative emotions.

One of the key limitations of the current research was the use of the MMI as the only measure of media multitasking behaviour. People tend to be poor estimators of their own behaviour (e.g., Boase & Ling, 2013; Brasel & Gips, 2011; Kahn, Ratan & Williams, 2014; Scharkow, 2016), particularly over longer periods of time. The MMI asks participants to provide the amount of time spent doing a particular activity over an average week. Therefore the self-reported amount may not be an accurate reflection of the actual amount. Some people may even reflect and report on only the most recent week, and that could be influenced by events such as watching more TV during a sporting event, or using less social media prior to an exam. Future research could consider also having participants provide a daily account of media use, or obtain a report of weekly use but at a few different time points. Further, collateral reports or behavioural data could also be good ways of obtaining more accurate information about an individual's media multitasking behaviours. This could then reflect the relationship between media multitasking behaviours and psychosocial outcomes more accurately rather than only relying on self-reports of those over or underreporting their own use through poor estimation.

Another limitation of Study 3 could be the small stimuli set that was used for faces and words. It should be noted that although there were attempts to reduce recognisability of stimuli, participants could have become desensitised to the faces and words after multiple exposures across the three attention tasks. Future studies could endeavour to have a larger stimuli pool to address this limitation.

To further expand on the findings of the current research, future research could also investigate what the immediate effects of media multitasking would do to psychosocial well-being. This would provide insight on the extent to which media multitasking can rapidly affect mood states, either negatively or positively. It may be that media multitasking may quickly increase stress and anxiety which would lead to negative emotional states, or it might immediately produce a sense of temporary productivity which could lead to positive emotional states. For example, participants could be asked to use multiple media forms concurrently for a different amount of time (15mins, 1 hour, 2 hours), followed by a measure of emotional state and subjective well-being. This could also be done with participants using media while talking or eating with others face-to-face, followed by measures of well-being and interaction quality. Different types of media could be compared, considering some types of media could potentially be conducive to social interaction and relationship building (e.g., watching TV as a family and talking to each other about the show). In addition, emotional attention tasks could also be administered after a timed amount of media multitasking has occurred in a controlled setting. This would demonstrate whether media multitasking can influence attentional biases towards emotions, which is also likely to be influenced by the type and content of the media shown. Therefore, one group could be exposed to negative content from two media forms (e.g., violent) and another be exposed to positive content from the same two media forms (e.g., humorous).

The current research examined emotion processing of media multitaskers through the use of three established attention tasks. While this provides insight on attentional biases towards emotions, there are a number of other types of emotion processing tasks that could be used in future research to determine other aspects of emotion processing besides attention. This would build on the current research to provide a broader indication of emotion processing in media multitaskers including perception and identification of emotions, and at varying intensities. Wilhelm et al. (2014) reviewed 16 tasks that measure perception and recognition of emotions, including task difficulty and reliability. Similarly, given the prevalent link between media multitasking and empathy levels, this could be further explored through the use of more direct behavioural measures of empathy and its multiple facets (Neumann & Westbury, 2011). These measures would reduce inaccurate self-reporting perhaps due to social desirability, and could include pictorial elicitation of affective empathy (Lindeman, Koirikivi & Lipsanen, 2016) neuroimaging, skin conductance, and heart rate measures (Neumann & Westbury, 2011). The relationship between empathy levels in media multitaskers and their emotion processing task performance could also then be investigated. These would expand on the link between media multitasking and empathy, and demonstrate whether higher levels of media multitasking affects emotion processing that would ultimately influence empathic behaviours towards others.

Summary of Research Conclusions

Media multitasking behaviour is usually cultivated over a long period of time and consistent engagement with this pattern of behaviour. There is increasing evidence to suggest that this can contribute to poorer psychosocial well-being, and as the current findings in Study 1 demonstrate, even in more enduring trait-like symptoms. Study 1 extends Becker et al.'s findings of a relationship between media multitasking, negative psychosocial well-being, and personality traits. Exploratory analyses indicate that different types of media multitasking activities can have negative or positive relationship with well-being. Study 1 also demonstrated that media multitasking partially mediated the relationship between personality traits and psychosocial outcomes. It is suggested that perhaps people with certain personality traits are more likely to media multitask, which then contributes to poor well-being.

According to the present research (Study 3), there are no significant differences between media multitasking groups on general attention task performance of faces and words on the dot-probe task, visual search task, or AB task. There was some evidence to suggest that HMM were more fixated on happy faces but reacted more quickly to angry faces on the dot-probe task, which was partially consistent with the only other study that has examined media multitasking and emotion processing on an attention task (Shukla, 2016). These findings are new as no previous research has examined emotion processing in media multitaskers across these three tasks for both faces and words. Perhaps, as previous research has shown (e.g., Cardoso-Leite et al., 2016; Ophir et al., 2009; Ralph & Smilek, 2017), media multitasking only has a link between some cognitive tasks, such as task switching, filtering or working memory tasks, that do not necessarily include emotion processing. In conclusion, the present research provides evidence that media multitasking behaviours should be engaged in with caution as there could be negative implications on a number of facets of well-being. However, the current evidence suggests that media multitasking may not be detrimental in all areas, and does not appear to impair emotional attention task performance.

REFERENCES

Allemand, M., Steiger, A. E., & Fend, H. A. (2014). Empathy development in adolescence predicts social competencies in adulthood. *Journal of Personality.* doi: 10.1111/jopy.12098.

Alpers, G. W., & Gerdes, A. B. (2007). Here is looking at you: emotional faces predominate in binocular rivalry. *Emotion, 7*, 495-506. doi: 10.1037/1528-3542.7.3.495

Alzahabi, R., & Becker, M. W. (2013). The association between media multitasking, task-switching, and dual-task performance. *Journal of Experimental Psychology: Human Percetion and Performance, 39,* 1485-1495. doi: 10.1037/a0031208.

Ames, D. R., Rose, P., & Anderson, C. P. (2006). The NPI-16 as a short measure of narcissism. *Journal of Research in Personality, 40*, 440-450. doi: 10.1016/j.jrp.2005.03.002

Amichai-Hamburger, Y., & Etgar, S. (2016). Intimacy and smartphone multitasking – A new oxymoron?. *Psychological Reports,* 1-13. doi: 10.1177/0033294116662658.

Anderson, A. K. (2005). Affective influences on the attentional dynamics supporting awareness. *Journal of Experimental Psychology: General, 134*, 258-281. doi: 10.1037/0096-3445.134.2.258

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y. (2004). An integrated theory of the mind. *Psychological Review, 111*, 1036-1060. doi: 10.1037/0033-295X.111.4.1036

Anglim, J., & Grant, S. (2016). Predicting psychological and subjective well-being from personality: Incremental prediction from 30 facets over the Big 5. *Journal of happiness studies, 17,* 59-80. doi: 10.1007/s10902-014-9583-7

Arend, I., & Botella, J. (2002). Emotional stimuli reduce the attentional blink in sub-clinical anxious subjects. *Psicothema, 14*, 209-214.

Armor, D. (2002). A 15-item short version of the NPI. Unpublished manuscript, Yale University.

Arnell, K. M., & Stubitz, S. M. (2010). Attentional blink magnitude is predicted by the ability to keep irrelevant material out of working memory. *Psychological Research, 74*, 457-467. doi: 10.1007/s00426-009-0265-8

Ashwin, C., Wheelwright, S., & Baron-Cohen, S. (2006). Finding a face in the crowd: testing the anger superiority effect in Asperger Syndrome. *Brain Cogn, 61*, 78-95. doi: 10.1016/j.bandc.2005.12.008

Asmundson, G. J. G., & Stein, M. B. (1994). Selective processing of social threat in patient with generalized social phobia: Evaluation using a dot-probe paradigm. *Journal of Anxiety Disorders, 8*, 107-117. doi: 10.1016/0887-6185(94)90009-4.

Banyai, F., Zsila, A., Kiraly, O., Maraz, A., Elekes, Z., Griffiths, M. D., et al. (2017). Problematic social media use: Results from a large-scale nationally representative adolescent sample. *PLoS ONE, 12.* doi: https://doi.org/10.1371/journal.pone.0169839.

Barnard, P., Ramponi, C., Battye, G., & Mackintosh, B. (2005). Anxiety and the deployment of visual attention over time. *Visual Cognition, 12,* 181-211. doi: 10.1080/13506280444000139.

Baumgartner, S. E., van der Schuur, W. A., Lemmens, J. S., & te Poel, D. (2017). The relationship between media multitasking and attention problems in adolescents: Results of two longitudinal studies. *Human Communication Research.* doi: 10.1111/hcre.12111.

Baumgartner, S. E., Weeda, W. D., Heijden, van der, L. L., & Huizinga, M. (2014). The relationship between media multitasking and executive function in early adolescents. *The Journal of Early Adolescents, 34,* 1120-1144. doi: 10.1177/0272431614523133

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders.* New York: International Universities Press.

Becker, D. V., Anderson, U. S., Motensen, C. R., Neufeld, S. L., & Neel, R. (2011). The face in the crowd effect unconfounded: Happy faces, not angry faces, are more efficiently detected in single- and multiple-target visual search tasks. *Journal of Experimental Psychology: General, 140*(4), 637-659. doi: 10.1037/a0024060.supp

Becker, M. W., Alzahabi, R., & Hopwood, C. J. (2013). Media multitasking is associated with symptoms of depression and social anxiety. *Cyberpsychology, Behaviour, and Social Networking, 16*, 132-135. doi: 10.1089/cyber.2012.0291

Bistricky, S. L., Harrison, J., Tran, K., & Schield, S. (2016). Attending to emotional faces: Interpersonal connections and depression history. *Journal of Social and Clinical Psychology, 35,* 202-234.

Blatny, M., Millova, K., Jelinek, M., & Osecka, T. (2015). Personality predictors of successful development: Toddler temperament and adolescent personality traits predict well-being and career stability in middle adulthood. *PLoS ONE, 10,* doi: 10.1371/journal.pone.0126032.

Boase, J., & Ling, J. (2013). Measure mobile phone use: Self-report versus log data. *Journal of Computer-Mediated Communication, 18,* 508-519. doi: 10.1111/jcc4.12021.

Borst, J., & Taatgen, N. (2007). The costs of multitasking in threaded cognition. In proceedings of ICCM. *Eighth International Conference on Cognitive Modeling.*

Oxford, UK: Taylor & Francis Psychology Press.

Borton, J. L., Oakes, M. A., & Lengieza, M. (2017). Fixated on rejection: Attentional blindness following socially rejecting faces in people with defensive self-esteem. *Self and Identity, 16,* 62-81. doi: 10.1080/15298868.2016.1218924.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36,* 129-148.

Bradley, M. M., & Lang, P. J. (1999). Affective norms for English words (ANEW): Instruction manual and affective ratings. Technical Report C-1, The Center for Research in Psychophysiology, University of Florida.

Bradley, B. P., Mogg, L., & Lee, S. C. (1997). Attentional biases for negative information in induced and naturally occurring dysphoria. *Behavior Research and Therapy, 35,* 911-927. doi: 10.1016/S0005-7967(97)00053-3.

Bradley, B. P., Mogg, K., & Millar, N. H. (2000). Covert and overt orienting of attention to emotional faces in anxiety. *Cognition & Emotion, 14*, 789-808. doi: 10.1080/02699930050156636

Bradley, B. P., Mogg, K., White, J., Groom, C., & de Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *British Journal of Clinical Psychology, 38*, 267-278.

Brasel, S. A., & Gips, J. (2011). Media multitasking behaviour: Concurrent television and computer usage. *Cyberpsychology, Behavior, and Social Networking, 14,* 527-534. doi: 10.1089/cyber.2010.0350.

Broadbent, D. E., & Broadbent, M. H. P. (1987). From detection to identification: Response to multiple targets in rapid serial visual presentation. *Perception & Psychophysics, 42*, 105. doi:10.3758/BF03210498.

Byrne, A., & Eysenck, M. W. (1995). Trait anxiety, anxious mood, and threat detection. *Cognition and Emotion, 9*, 549-562. doi: 10.1080/02699939508408982

Cain, M. S., & Mitroff, S. R. (2011). Distractor filtering in media multitaskers. *Perception, 40*, 1183-1192. doi: 10.1068/p7017

Calhoun, G. B., Glaser, B. A., Stefurak, T., & Bradshaw, C. P. (2000). Preliminary validation of the narcissistic personality inventory-juvenile offender. *International Journal of Offender Therapy and Comparative Criminology, 44,* 564-580.

Campbell, W. K., Rudich, E., & Sedikides, C. (2002). Narcissism, self-esteem, and the positivity of self- views: Two portraits of self-love. *Personality & Social Psychology Bulletin, 28*, 358–368. doi: 10.1177/0146167202286007

Cardoso-Leite, P., Kludt, R., Vignola, G., Ma, W. J., Green, C., & Bavelier, D. (2016). Technology consumption and cognitive control: Contrasting action video game experience with media multitasking. *Attention, Perception & Psychophysics, 78,* 218-241. doi: 10.3758/s13414-015-0988-0.

Carnicer, J. G., & Calderon, C. (2014). Empathy and coping strategies as predictors of well-being in Spanish university students. *Electronic Journal of Research in Educational Psychology, 12,* 129-146. doi: 10.14204/ejrep.32.13117

Chen, Y. P., Ehlers, A., Clark, D. M., & Mansell, W. (2002). Patients with generalized social phobia direct their attention away from faces. *Behaviour Records and Therapy, 40*, 677-687.

Chiappelli, J., Nugent, K. L., Thangavelu, K., Searcy, K., & Hong, L. E. (2014). Assessment of trait and state aspects of depression in schizophrenia. *Schizophrenia Bulletin, 40,* 132-142. doi: 10.1093/schbul/sbt069.

Chun, M. M., & Potter, M. C. (1995). A two-stage model for multiple target detection in rapid serial visual presentation. *Journal of Experimental: Human Perception and Performance, 21*, 109-127.

Choisdealbha, A. N., Piech, R. M., Fuller, J. K., & Zald, D. H. (2017). Reaching back: The relative strength of the retroactive emotional attentional blink. *Scientific Reports, 7.* doi: 10.1038/srep43645.

Clark, L. A., & Watson, D. (1999). Temperament: A new paradigm for trait psychology. In L. A. Pervin & O. P. John (Eds.). *Handbook of personality: Theory and research* (2nd ed., pp. 399-423). New York: Guilford.

Cohen, D. J., Eckhardt, C. I., & Schagat, K. D. (1998). Attention allocation and habituation to anger-related stimuli during a visual search task. *Aggressive Behavior, 24,* 399-409. doi: 10.1002/(SICI)1098-2337(1998)24:6<399::AID-ABI>3.0.CO;2-I

Colligan, T. W., & Higgins, E. M. (2006). Workplace stress. *Journal of Workplace Behavioural Health, 21,* 89-97. doi: 10.1300/J490v21n02_07.

Connor KM, Davidson JRT, Churchill LE, et al. Psychometric properties of the Social Phobia Inventory (SPIN): new self- rating scale. British Journal of Psychiatry 2000; 176:379–86.

Cruwys, T., Dingle, G. A., Haslam, C., Haslam, S. A., Jetten, J., & Morton, T. A. (2013). Social group memberships protect against future depression, alleviate depression symptoms and prevent depression relapse. *Social Science & Medicine, 98,* 179-186. Doi: 10.1016/j.socscimed.2013.09.013

Dalgleish, T., Moradi, A. R., Taghavi, M. R., Neshat-Doost, H. T., & Yule, W. (2001). An experimental Investigation of hypervigilance for threat in children and adolescents with post-traumatic stress disorder. *Psychol Med, 31*, 541-547.

de Jong, P. J., & Martens, S. (2007). Detection of emotional expressions in rapidly changing facial displays in high- and low-socially anxious women. *Behaviour Research and Therapy, 45*, 1285-1294. doi: 10.1016/j.brat.2006.10.003

de Jong, P. J., Koster, E. H. W., van Wees, R., & Martens, S. (2009). Emotional facial expressions and the attentional blink: Attenuated blink for angry and happy faces irrespective of social anxiety. *Cognition & Emotion, 23*, 1640-1652. doi: 10.1080/02699930802490227

Dear, B. F., Sharpe, L., Nicholas, M. K., & Refshauge, K. (2011). Pain-related attentional biases: The importance of personal relevance and ecological validity of stimuli. *The Journal of Pain, 12,* 625-632.

Derakshan, N., & Koster, E. H. W. (2010). Processing efficiency in visual search in anxiety: An eye-movement registration study. *Behavior Research and Therapy, 48*, 1180-1185.

Di Lollo, V., Kawahara, J., Ghorashi, S. M. S., & Enns, J. T. The attentional blink: Resource depletion or temporary loss of control? *Psychological Research, 69,* 191-200. doi: 10.1007/s00426-004-0173-x.

Dickinson, K. A., & Pincus, A. L. (2003). Interpersonal analysis of grandiose and vulnerable narcissism. *Journal of Personality Disorders, 17,* 188-207.

Diener, E., Oishi, S., & Lucas, R. E. (2003). Personality, culture, and subjective well-being: Emotional and cognitive evaluations of life. *Annual Review of Psychology, 54,* 403-425. doi: 10.1146/annurev.psych.54.101601.145056.

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*, 11-

23. doi: 10.1080/15252019.2014.884480

Duncan, J., & Humphreys, G. W. (1989). Visual search and stimulus similarity. *Psychological Review, 96,* 433-458. doi: 10.1037/0033-295X.96.3.433.

Dux, P. E., & Marois, R. (2009). The attentional blink: A review of data and theory. *Attention, Perception and Psychophysiology, 71,* 1683-1700. doi: 10.3758/APP.71.8.1683.

Eagles, S., & Murphy, K. (2016). Inverted, upright, and blurred faces are not immune to the attentional blink. *Perception, 45,* 893-909. doi: 10.1177/0301006616643665.

Ehrman, R. M., Robbins, S. J., Bromwell, M. A., Lankford, M. E., Monterosso, J. R., & O'Brien, C. P. (2002). Comparing attentional bias to smoking cues in current smokers, former smokers, and nonsmokers using a dot-probe task. *Drug and Alcohol Dependence, 67,* 185-191.

Ekman, P., & Friesen, W. V. (1976). *Pictures of facial affect.* Palo Alto, CA: Consulting Psychologists Press.

Farran, E. K., Branson, A., & King, B. J. (2011). Visual search for basic emotional expressions in autism; impaired processing of anger, fear and sadness, but a typical happy face advantage. *Research in Autism Spectrum Disorders, 5*, 455-462. doi: 10.1016/j.rasd.2010.06.009

Faul, F., Erdfelder, E., Lang A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Forster, K. I., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers, 35,* 116-124. doi: https://doi.org/10.3758/BF03195503.

Fox, E. (2002). Processing emotional facial expressions: The role of anxiety and awareness. *Cognitive, Affective, & Behavioural Neuroscience, 2*, 52-63.

Fox, E., & Damjanovic, L. (2006). The eyes are sufficient to produce a threat superiority effect. *Emotion, 6*, 534-539. doi: 10.1037/1528-3542.6.3.534

Fox, E., Russo, R., & Georgiou, G. A. (2005). Anxiety modulates the degree of attentive resources required to process emotional faces. *Cognitive, Affective, & Behavioural Neuroscience, 5*, 396-404.

Galinha, I. C., Garcia-Martin, M. A., Oishi, S., Wirtz, D., & Esteves, F. (2016). Cross-cultural comparison of personality traits, attachment security, and satisfaction with relationships as predictors of subjective well-being in India, Sweden, and the United States. *Journal of Cross-Cultural Psychology, 47,* 1033-1052. doi: 10.1177/0022022116658262.

Garrett, R. K., & Denziger, J. N. (2008). On cyberslacking: Workplace status and personal internet use at work. *Cyberpsychology & Behavior, 11,* 287-292. doi: 10.1089/cpb.2007.0146.

Georgiou, G. A., Bleakley, C., Hayward, J., Russo, R., Dutton, K., Eltiti, S., & Fox, E. (2005). Focusing on fear: Attentional disengagement from emotional faces. *Vis cogn, 12*, 145-158. doi: 10.1080/13506280444000076

Gerritsen, C., Frischen, A., Blake, A., Smilek, D., & Eastwood, J. D. (2008). Visual search is not blind to emotion. *Perception & Psychophysics, 70*(6), 1047-1059. doi: 10.3758/PP.70.6.1047

Giedd, J. N. (2012). The digital revolution and adolescent brain evolution. *Journal of Adolescent Health, 51,* 101-105. doi: 10.1016/j.jadohealth.2012.06.002

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional Biases for Facial Expressions in Social Phobia: The Face-in-the-Crowd Paradigm. *Cognition & Emotion, 13*, 305-318. doi: 10.1080/026999399379294

Gilboa-Schechtman, E., Presburger, G., Maron, S., & Hermesh, H. (2005). The effects of social anxiety and depression on the evaluation of facial crowds. *Behavior Research and Therapy, 43,* 467-474. doi: 10.1016/j.brat.2004.03.001.

Goldberg, L. R. (1990). An Alternative "Description of Personality": The Big-Five Factor Structure. *Personality Processes and Individual DIfferences*, 1216-1229.

Goswami, H. (2014). Children's subjective well-being: Socio-demographic characteristics and personality. *Child Indicators Research, 7,* 119-140. doi: 10.1007/s12187-012-9205-7.

Gotlib, I. H., Krasnoperova, E., Yue, D. N., & Joormann, J. (2004). Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of Abnormal Psychology, 113,* 127-135.

Gotlib, I. H., McLachlan, A. L., & Katz, A. N. (1988). Biases in visual attention in depressed and nondepressed individuals. *Cognition and Emotion, 2,* 185-200.

Gross, E. F. (2004). Adolescent Internet use: What we expect, what teens report. *Applied Developmental Psychology*, *25*, 633–649. doi: 10.1016/j.appdev.2004.09.005.

Grynberg, D., Vermeulen, N., & Luminet, O. (2013). Amplification of attentional blink by distress-related facial expressions: Relationships with alexithymia and affectivity. *International Journal of Psychology.* doi: 10.1002/ijop.12006.

Ha, S. E., & Kim, S. (2013). Personality and subjective well-being: Evidence from South Korea. *Social Indicators Research, 111,* 341-359. doi: 10.1007/s11205-012-0009-9.

Hadwin, J. A., Donnelly, N., French, C. C., Richards, A., Watts, A., & Daley, D. (2003). The influence of children's self-report trait anxiety and depression on visual search for emotional faces. *Journal of Child Psychology and Psychiatry, 44*, 432-444

Hahn, S., Carlson, C., Singer, S., & Gronlund, S. D. (2006). Aging and visual search: automatic and controlled attentional bias to threat faces. *Acta Psychol (Amst), 123*, 312-336. doi: 10.1016/j.actpsy.2006.01.008

Hansen, C. H., & Hansen, R. D. (1988). Finding the face in the crowd: An anger superiority effect. *Journal of Personality and Social Psychology, 54*(6), 917-924.

Hayes, N., & Joseph, S. (2003). Big 5 correlates of three measures of subjective well-being. *Personality and Individual Differences, 34,* 723-727.

Hee, O. C. (2014). Validity and reliability of the Big Five personality traits scale in Malaysia. *International Journal of Innovation and Applied Studies, 5(4),* 309-315.

Heim-Dreger, U., Kohlmann, C. W., Eschenbeck, H., & Burkhardt, U. (2006). Attentional biases for threatening faces in children: vigilant and avoidant processes. *Emotion, 6*, 320-325. doi: 10.1037/1528-3542.6.2.320

Helfinstein, S. M., White, L. K., Bar-Haim, Y., & Fox, N. A. (2008). Affective primes suppress attention bias to threat in socially anxious individuals. *Behavior Research and Therapy, 46,* 799-810. doi: 10.1016/j.brat.2008.03.011.

Herlitz, A., & Loven, J. (2013). Sex differences and the own-gender bias in face recognition: A meta-analystic review. *Visual Cognition, 21,* 1306-1336. doi: 10.1080/13506285.2013.823140.

Hershler, O., & Hochstein, S. (2005). At first sight: a high-level pop out effect for faces. *Vision Research, 45*, 1707-1724. doi: 10.1016/j.visres.2004.12.021

Hill, A. B., & Dutton, F. (1989). Depression and selective attention to self-esteem threatening words. *Personality and Individual Differences, 10,* 915-917.

Hommel, B., & Akyurek, E. G. (2005). Lag-1 sparing in the attention blink: benefits and costs of intergrating two events into a single episode. *The Quarterly Journal of Experimental Psychology Section A, 58,* 1415-1433. doi: 10.1080/02724980443000647.

Houston, T. K., Cooper, L. A., & Ford, D. E. (2002). Internet support groups for depression: A 1-year prospective cohort study. *American Journal of Psychiatry, 159,* 2062-2068. doi: 10.1176/appi.ajp.159.12.2062

Hunley, S. A., Evans, J. H., Delgado-Hachey, M., Krise, J., Rich, T., Schell, C. (2005). Adolescent computer use and academic achievement. *Adolescence, 40*, 307–318.

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

John, O. P., & Srivastava, S. (1999). The Big-Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.). *Handbook of Personality: Theory and Research* (Vol. 2, pp. 102-138). New York: Guilford Press.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The big five inventory – versions 4a and 54.* Berkley, CA: University of California, Berkley, Institute of Personality and Social Research.

Joormann, J., & Gotlib, I. H. (2007). Selective attention to emotional faces following recovery from depression. *Journal of Abnormal Psychology, 116*, 80-85. doi: 10.1037/0021-843X.116.1.80

Joormann, J., Talbot, L., & Gotlib, I. H. (2007). Biased processing of emotional information in girls at risk for depression. *Journal of Abnormal Psychology, 116*, 135-143. doi: 10.1037/0021-843X.116.1.135

Kahn, A. S., Ratan, R., & Williams, D. (2014). Why we distort in self-report: Predictors of self-report errors in video game play. *Journal of Computer-Mediated Communication, 19,* 1010-1023. doi: 10.1111/jcc4.12056.

Kang, J., Ham, B. J., & C. W. (2017). Cannot avert the eyes: Reduced attentional blink toward others' emotional expressions in empathic people. *Psychonomic Bulletin & Review, 24,* 810-820. doi: 10.3758/s13423-016-1171-x

Karparova, S. P., Kersting, A., & Suslow, T. (2005). Disengagement of attention from facial emotion in unipolar depression. *Psychiatry and Clinical Neurosciences, 59*, 723-729.

Kazakova, S., Cauberghe, V., Pandelaere, M., & De Pelsmacker, P. (2015). Can't see the forest for the trees? The effect of media multitasking on cognitive processing style. *Media Psychology, 18,* 425-450. doi: https://doi.org/10.1080/15213269.2015.1006789.

Kealy, D., Tsai, M., & Ogrodniczuk, J. S. (2012). Depressive tendencies and pathological narcissism among psychiatric outpatients. *Psychiatry Research.* doi: 10.1016/j.psychres.2011.08.023.

Keil, A., & Ihssen, N. (2004). Identification facilitation for emotionally arousing verbs during the attentional blink. *Emotion, 4*, 23-35. doi: 10.1037/1528-3542.4.1.23

Keil, A., Ihssen, N., & Heim, S. (2006). Early cortical facilitation for emotionally arousing targets during the attentional blink. *BMC Biology, 4,* 23-25

Khatibi, A., Dehghani, M., Sharpe, L., Asmundson, G. J., & Pouretemad, H. (2009). Selective attention towards painful faces among chronic pain patients: evidence from a modified version of the dot-probe. *Pain, 142*, 42-47. doi: 10.1016/j.pain.2008.11.020

Koster, E. H., De Raedt, R., Verschuere, B., Tibboel, H., & De Jong, P. J. (2009). Negative information enhances the attentional blink in dysphoria. *Depression and Anxiety, 26*. doi: 10.1002/da.20420

Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking “Big” personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin, 136,* 768-821. doi: 10.1037/a0020327.

Kujawa, A. J., Torpey, D., Kim, J., Hajcak, G., Rose, S., Gotlib, I. H., & Klein, D. N. (2011). Attentional biases for emotional faces in young children of mothers with chronic or recurrent depression. *J Abnorm Child Psychol, 39*, 125-135. doi: 10.1007/s10802-010-9438-6

Landers, R. N., & Lounsbury, J. W. (2006). An investigation of Big Five and narrow personality traits in relation to internet usage. *Computers in Human Behavior, 22,* 283-293. doi: 10.1016/j.chb.2004.06.001.

Lange, W. G., Heuer, K., Langner, O., Keijsers, G. P., Becker, E. S., & Rinck, M. (2011). Face value: eye movements and the evaluation of facial crowds in social anxiety. *Journal of Behavior Therapy and Experimental Psychiatry, 42*, 355-363. doi: 10.1016/j.jbtep.2011.02.007

Lawson, R., Waller, G., Sines, J., & Meyer, C. (2008). Emotional awareness among eating-disordered patients: The role of narcissistic traits. *European Eating Disorders Review, 16,* 44-48.

Lau, K. S. L., Marsee, M. A. Kunimatsu, M. M., & Fassnacht, G. M. (2010). Examining associations between narcissism, behaviour problems, and anxiety in non-referred adolescents. *Child Youth Care Forum.* doi: 10.1007/s10566-010-9135-1.

Leary, M. R. (1983). The Interaction Anxiousness Scale: Construct and criterion-related validity. *Journal of Personality Assessment, 61,* 136-146. doi: 10.1207/s15327752jpa6101_10

Lepp, A., Barkley, J. E., & Karpinski, A. C. (2014). The relationship between cell phone use, academic performance, anxiety, and Satisfaction with Life in college students. *Computers in Human Behaviour, 31,* 343-350. doi: 10.1016/j.chb.2013.10.049

Leung, A., Kier, C., Fung, T., Fung, L., & Sproule, R. (2011). Searching for happiness: The importance of social capital, 12, 443-463. *Journal of Happiness Studies.* doi: 10.1007/s10902-010-9208-8.

Levesque, C., Lafontaine, M., Caron, A., Lyn Flesch, J., & Bjornson, S. (2014). Dyadic empathy, dyadic coping, and relationship satisfaction: A dyadic model. *Europe Journal of Psychology, 10,* 118-134. doi: 10.5964/ejop.v10i1.697

Lindeman, M., Koirikivi, I., & Lipsanen, J. (2016). Pictorial Empathy Test (PET): An easy-to-use method for assessing affective empathic reactions. *European Journal of Psychological Assessment.* doi: 10.1027/1015-5759/a000353.

Lipp, O. V., Price, S. M., & Tellegen, C. L. (2009). No effect of inversion on attentional and affective processing of facial expressions. *Emotion, 9*, 248-259. doi: 10.1037/a0014715

Liu, C., & Yu, C. (2013). Can Facebook use induce well-being? *Cyberpsychology, Behaviour, and Social Networking, 16,* 674-678. doi: 10.1089/cyber.2012.0301.

Lopes, P. N., Salovey, P., & Straus, R. (2003). Emotional intelligence, personality, and the perceived quality of social relationships. *Personality and Individual Differences, 35,* 641-658. doi: 10.1016/S0191-8869(02)00242-8

Lubman, D. I., Peters, L. A., Mogg, K., Bradley, B. P., & Deakin, J. F. W. (2000). Attentional bias for drug cues in opiate dependence. *Psychological Medicine, 30,* 169-175

Lui, P. P., Rollock, D., Chang, E. C., Leong, F. T. L., & Zamboanga, B. L. (2016). Big 5 personality and subjective well-being in Asian Americans: Testing optimism and pessimism as mediators. *Asian American Journal of Psychology, 7,* 274-286. doi: 10.1037/aap0000054.

Lui, K. D. H., & Wong, A. C. N. (2012). Does media multitasking always hurt? A positive correlation between multitasking and multisensory integration. *Psychonomic Bulletin and Review, 19,* 647-664. doi: 10.3758/s13423-012-0245-7.

Lundqvist, D., & Ohman, A. (2005). Emotion regulates attention: the relation between facial configurations, facial emotion, and visual attention. *Visual Cognition, 12*, 51-84. doi: 10.1080/13506280444000085

Lundqvist, D., Bruce, N., & Ohman, A. (2014). Finding an emotional face in a crowd: Emotional and perceptual stimulus factors influence visual search efficiency. *Cognition and Emotion*, 1-13. doi: 10.1080/02699931.2014.927352

Lyobomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin, 131,* 803-855. doi: 10.1037/0033-2909.131.6.803.

Maclean, M. H., & Arnell, K. M. (2010). Personality predicts temporal attention costs in the attentional blink paradigm. *Psychonomic Bulletin and Review, 17*, 556-562. doi: 10.3758/PBR.17.4.556

Macleod, C., Mathews, A., & Tata, P. (1986). Attentional Bias in Emotional Disorders. *Journal of Abnormal Psychology, 95*, 15-20.

Madden, M. (2006). *Internet penetration and impact.* Washington, DC: Pew Internet and American Life Project.

Magen, H. (2017). The relations between executive functions, media multitasking and polychronicity. *Computers in Human Behavior, 67,* 1-9. doi: 10.1016/j.chb.2016.10.011.

Malkoç, A. (2011). Big five personality traits and coping styles predict subjective well-being: A study with a Turkish sample. *Procedia Social and Behavioural Sciences, 12,* 577-581. doi: 10.1016/j.sbspro.2011.02.070.

Malouff, J. M., Thorsteinsson, E. B., & Schutte, N. S. (2005). The relationship between the five-factor model of personality and symptoms of clinical disorders: A meta-analysis. *Journal of Psychopathology and Behavioural Assessment, 27,* 101-114. doi: 10.1007/s10862-005-5384-y.

Mansell, W., Clark, D. M., Ehlers, A., & Chen, Y.-P. (1999). Social Anxiety and Attention away from Emotional Faces. *Cognition & Emotion, 13*, 673-690. doi: 10.1080/026999399379032

Mansell, W., Ehlers, A., Clark, D., & Chen, Y.-P. (2002). Attention to Positive and Negative Social-Evaluative Words: Investigating the Effects of Social Anxiety, Trait Anxiety and Social Threat. *Anxiety, Stress & Coping, 15*, 19-29. doi: 10.1080/10615800290007263

Maratos, F. A., Mogg, K., & Bradley, B. P. (2008). Identification of angry faces in the attentional blink. *Cognition & Emotion, 22*, 1340-1352. doi:

10.1080/02699930701774218

Martin, M., Williams, R. M., & Clark, D. M. (1991). Does anxiety lead to selective processing of threat-related information? *Behavior Research and Therapy, 29,* 147-160. doi: 10.1016/0005-7967(91)90043-3

Masse, R., Poulin, C., Dasa, C., Lambert, J., Belair, S., & Battaglini, A. (1998a). Elaboration and validation of a tool to measure psychological well-being: WBMMS. *Canadian Journal of Public Health, 89,* 352-357.

Masse, R., Poulin, C., Dasa, C., Lambert, J., Belair, S., & Battaglini, A. (1998b). The structure of mental health higher-order confirmatory factor analyses of psychological distress and well-being measures. *Social Indicators Research, 45,* 475-504. Doi: 10.1023/A:1006992032387

Mather, M., & Carstensen, L. L. (2003). Aging and attentional biases for emotional faces. *Psychological Science, 14*, 409-415.

Mather, M., & Knight, M. R. (2006). Angry faces get noticed quickly: Threat detection is not impaired among older adults. *Journal of Gerontology: Psychological Sciences, 61B*, 54-57.

Mathews, A., & Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. *Cognitive Therapy and Research, 22,* 539-560. doi: https://doi.org/10.1023/A:1018738019346.

Mathews, A., & Macleod, C. (1985). Selective processing of threat cues in anxiety states. *Behavior Research and Therapy, 23,* 563-569.

Mathews, A., Ridgeway, V., & Williamson, D. A. (1996). Evidence for attention to threatening stimuli in depression. *Behaviour Research and Therapy, 34,* 695-705.

Mathewson, K. J., Arnell, K. M., & Mansfield, C. A. (2008). Capturing and holding attention: The impact of emotional words in rapid serial visual presentation. *Memory & Cognition, 36,* 182-200. doi: https://doi.org/10.3758/MC.36.1.182.

McCann, S. J. H. (2011). Emotional health and the big five personality factors at the American state level. *Journal of Happiness Studies, 12,* 547-560. doi: 10.1007/s10902-010-9215-9.

McCrae, R. R., & Costa, P. T. Jr. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52,* 81-90.

McCrae, R. R., & Costa, P. T. Jr. (1991). The NEO Personality Inventory: Using the five-factor model in counselling. *Journal of Counseling & Development, 69,* 367-372. doi: https://doi.org/10.1002/j.1556-6676.1991.tb01524.x.

McDaniel, B. T., & Coyne, S. M. (2016). "Technoference": The interference of technology in couple relationships and implications for women's personal and relational well-being. *Psychology of Popular Media Culture, 5,* 85-98. doi: 10.1037/ppm0000065

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). Profile of Mood States. Educational and Industrial Testing Service.

Minear, M., Brasher, F., McCurdy, M., Lewis, J., & Younggren, A. (2013). Working memory, fluid intelligence, and impulsiveness in heavy media multitaskers. *Psychonomic Bulletin and Review, 20*(6), 1274-1281. doi: 10.3758/s13423-013-0456-6

Misra, S., Cheng, L., Genevie, J., & Yuan, M. (2016). The iPhone effect: The quality of in-persona social interactions in the presence of mobile devices. *Environment and Behaviour, 48,* 275-298. doi: 10.1177/0013916514539755.

Miyazawa, S., & Iwasaki, S. (2010). Do happy faces capture attention? The happiness superiority effect in attentional blink. *Emotion, 10*(5), 712-716. doi: 10.1037/a0019348

Mogg, K., & Bradley, B. P. (2002). Selective orienting of attention to masked threat faces in social anxiety. *Behavior Research and Therapy, 40*, 1403-1414

Mogg, K., Philippot, P., & Bradley, B. P. (2004). Selective attention to angry faces in clinical social phobia. *Journal of Abnormal Psychology, 113*, 160-165. doi: 10.1037/0021-843X.113.1.160

Moody, E. J. (2001). Internet use and its relationship to loneliness. *Cyberpsychology & Behavior, 4,* 393-401. doi: 10.1089/109493101300210303.

Morrison, A. S., Brozovich, F. A., Lakhan-Pal, S., Jazaieri, H., Goldin, P. R., Heimberg, R. G., et al. (2016). Attentional blink impairment in social anxiety disorder: Depression comorbidity matters. *Journal of Behavior Therapy and Experimental Psychiatry, 50,* 209-214. doi: 10.1016/j,jbtep.2015.08.006.

Moser, C., Schoenebeck, S. Y., & Reinecke, K. (2016). Technology at the table: Attitudes about mobile phone use at mealtimes. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems,* 1881-1892. doi: 10.1145/2858036.2858357.

Mount, M. K., Barrick, M. R., & Strauss, J. P. (1994). Validity of observer ratings of the big five personality factors. *Journal of Applied Psychology, 79,* 272-280.

Neshat-Doost, H. T., Moradi, A. R., Taghavi, M. R., Yule, W., & Dalgleish, T. (2000). Lack of attentional bias for emotional information in clinically depressed children and adolescents on the dot probe task. *Journal of Child Psychology and Psychiatry, 41*, 363-368.

Neumann, D. L., & Westbury, H. R. (2011). The psychophysiological measure of empathy. In D. J. Seapaletti (Ed.), *Psychology of Empathy*. Retrieved from http://hdl.handle.net/10072/44076

Noftle, E. E., & Shaver, P. R. (2006). Attachment dimensions and the big five personality traits: Associations and comparative ability to predict relationship quality. *Journal of Research in Personality, 40,* 179-208. doi: 10.1016/j.jrp.2004.11.003.

Ogawa, T., & Suzuki, N. (2004). On the saliency of negative stimuli: Evidence from attentional blink. *Japanese Psychological Research, 46*, 20-30.

Ohannessian, C. M. (2009). Media use and psychological adjustment: An examination of gender differences. *Journal of Child and Family Studies, 18,* 582-593. doi:10.1007/s10826-009-9261-2

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality and Social Psychology, 80*, 381-396.

Olivers, C. N., & Meeter, M. (2008). A boost and bounce theory of temporal attention. *Psychological Review, 115,* 838-863. doi: 10.1037/a0013395.

Olivers, C. N., & Nieuwenhuis, S. (2005). The beneficial effect of concurrent task-irrelevant mental activity on temporal attention. *Psychological Science, 16,* 265-269.

Ophir, E., Nass, C., & Wagner, A. D. (2009). Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences USA, 106*, 15583-15587. doi: 10.1073/pnas.0903620106

Overall, J. E., & Gorham, D. R. (1962). The Brief Psychiatric Rating Scale. *Psychological Reports, 10,* 799-812. doi: https://doi.org/10.2466/pr0.1962.10.3.799.

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., . . . Zhou, M. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8- to 12-year-old girls. *Developmental Psychology, 48*, 327-336. doi: 10.1037/a0027030

Pinkham, A. E., Griffin, M., Baron, R., Sasson, N. J., & Gur, R. C. (2010). The face in the crowd effect: Anger superiority when using real faces and multiple identities. *Emotion, 10*, 141-146. doi: 10.1037/a0017387.supp

Pinquart, M, & Corensen, S. (2000). Influences of socioeconomic status, social network, and competence on subjective well-being in later life: A meta-analysis. *Psychology and Aging, 15,* 187-224. doi: 10.1037/0882-7974.15.2.187.

Pishyar, R., Harris, L. M., & Menzies, R. G. (2004). Attentional bias for words and faces in social anxiety. *Anxiety, Stress & Coping, 17,* 23-26. doi: 10.1080/106115800310001601458.

Price, R. B., Siegle, G. J., Silk, J. S., Ladouceur, C. D., McFarland, A., Dahl, R. E., & Ryan, N. D. (2014). Looking under the hood of the dot-probe task: an fMRI study in anxious youth. *Depress Anxiety, 31*, 178-187. doi: 10.1002/da.22255

Primack, B. A., Swanier, B., Georgiopoulos, A. M., Land, S. R., & Fine, M. J. (2009). Association between media use in adolescence and depression in young adulthood: A longitudinal study. *Archives of General Psychiatry, 66,* 181-188. doi: 10.1001/archgenpsychiatry.2008.532.

Przybylski, A. K., & Weinstein, N. (2013). Can you connect with me now? How the presence of mobile communication technology influences face-to-face conversation quality. *Journal of Social and Personal Relationships, 30,* 237-246. doi: 10.1177/0265407512453827.

Ralph, B. C. W., Seli, P., Wilson, K. E., & Smilek, D. (2018). Volitional media multitasking: Awareness of performance costs and modulation of media multitasking as a function of task demand. *Psychological Research.* doi: https://doi.org/10.1007/s00426-018-1056-x

Ralph, B. C. W., & Smilek,, D. (2017). Individual differences in media multitasking and performance on the n-back. *Attention, Perception & Psychophysics, 79,* 582-592. doi: https://doi.org/10.3758/s13414-016-1260-y.

Ralph, B. C. W., Thomson, D. R., Cheyne, J. A., & Smilek, D. (2013). Media multitasking and failures of attention in everyday life. *Psychological Research*. http://www.ncbi.nlm.nih.gov/pubmed/24178629 doi:10.1007/s00426-013-0523-7

RAMMtedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality, 41*, 203-212. doi: 10.1016/j.jrp.2006.02.001.

Rathvon, N., & Holmstrom, R. W. (1996). An MMPI-2 portrait of narcissism. *Journal of Personality Assessment, 66,* 1-19.

Raven, J., Raven J. C., & Court, J. H. (1998). *Manual for Raven's Progressive Matrices and Vocabulary Scales.* San Antonio, TX: Harcourt Assessment.

Raymond, J. E., Shapiro, K. L., & Arnell, K. M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink? *Journal of Experimental Psychology: Human Perception and Performance, 18*, 849-860.

Reinecke, L., Aufenanger, S., Beutel, M. E., Dreier, M., Quiring, O., Stark, B., et al. (2016). Digital stress over the life span: The effects of communication load and internet multitasking on perceived stress and psychological health impairments in a German probability sample. *Media Psychology,* 1-26. doi: 10.1080/15213269.2015.1121832.

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin, 26,* 419-435. doi: 10.1177/0146167200266002.

Rideout, V. (2016). Measuring time spent with media: The Common Sense census of media use by US 8-to 18-year-olds. *Journal of Children and Media, 10,* 138-144. doi: https://doi.org/10.1080/17482798.2016.1129808.

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). Generation M2: Media in the lives of 8-to- 18-year-olds. Menlo Park, Carlifornia: Henry J. Kaiser Family Foundation.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: distraction and enhancement in visual search. *Depress Anxiety, 18*, 18-28. doi: 10.1002/da.10105

Roberts, J. A., & David, M. E. (2016). My life has become a major distraction from my cell phone: Partner phubbing and relationship satisfaction among romantic partners. *Computers in Human Behavior, 54,* 134-141. doi: 10.1016/jchb.2015.07.058.

Roberts, K. E., Hart, T. A., & Eastwood, J. D. (2009). Attentional Biases to Social and Health Threat Words in Individuals With and Without High Social Anxiety or Depression. *Cognit Ther Res, 34*, 388-399. doi: 10.1007/s10608-009-9245-y

Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality. *Perspectives in Psychological Science, 2,* 313-345. doi: 10.1111/j.1745-6916.2007.00047.x.

Rokke, P. D., Arnell, K. M., Koch, M. D., & Andrews, J. T. (2002). Dual-task attention deficits in dysphoric mood. *Journal of Abnormal Psychology, 111*, 370-379.

Rosen, L. D., Whaling, K., Rab, S., Carrier, L. M., & Cheever, N. A. (2013). Is Facebook creating "iDisorders"? The link between clinical symptoms of psychiatric disorders and technology use, attitudes and anxiety. *Computers in Human Behaviour, 29,* 1243-1254. doi: 10.1016/j.chb.2012.11.012

Salemink, E., van den Hout, M. A., & Kindt, M. (2007). Selective attention and threat: quick orienting versus slow disengagement and two versions of the dot probe task. *Behaviour Research and Therapy, 45*, 607-615. doi: 10.1016/j.brat.2006.04.004

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

Sanbonmatsu, D. M., Strayer, D. L., Medeiros-Ward, N., & Watson, J. M. (2013). Who multi-tasks and why? Multi-tasking ability, perceived multi-tasking ability, impulsivity, and sensation seeking. *PLoS One, 8*, e54402. doi: 10.1371/journal.pone.0054402

Scharkow, M. (2016). The accuracy of self-reported internet use – A validation study using client log data. *Communication Method and Measures, 10.* Doi: 10.1080/19312458.2015.1118446.

Schönenberg, M., & Abdelrahman, T. (2013). In the face of danger: Exploring the attentional blink to emotional facial expressions in PTSD. *Psychiatry Research, 209,* 180-185.

Schwabe, L., & Wolf, O. T. (2010). Emotional modulation of the attentional blink: is there an effect of stress? *Emotion, 10*, 283-288. doi: 10.1037/a0017751

Selfhout, M. H. W., Branje, S. J. T., Delsing, M., ter Bogt, T. F. M., & Meeus, M. H. J. (2009). Different types of internet use, depression, and social anxiety: The role of perceived friendship quality. *Journal of Adolescence, 32,* 819-833. doi:

10.1016/j.adolescence.2008.10.011

Shapiro, K. L., Raymond, J. E., & Arnell, K. M. (1994). Attention to visual pattern information produces the attentional blink in rapid serial visual presentation. *Journal of Experimental Psychology: Human Perception and Performance, 20*, 357-371.

Shapiro, K., Schmitz, F., Martens, S., Hommel, B., & Schnitzler, A. (2006). Resource sharing in the attentional blink. *Neuroreport, 17*, 163-166.

Shields, C., & Murphy, K. (2011). Selective Attention and Health Anxiety: Ill-Health Stimuli are Distracting for Everyone. *Cognitive Therapy and Research 35*, 241-252. doi: 10.1007/s10608-011-9351-5

Shih, S.-I. (2013). A null relationship between media multitasking and well-being. *Public Library of Science One, 8*(5), e64508. doi: 10.1371/journal.pone.0064508

Shukla, S. (2016). Media multitaskers and attentional bias toward emotional stimuli. In Leung M. T., & Tan, L. (eds.), *Applied Psychology Readings* (pp 39-46). SCAP 2016: Springer, Singapore. doi: https://doi.org/10.1007/978-981-10-2796-3_3.

Singh, S., & Lal, R. (2012). A study of subjective well-being of adolescents in relation to big five factors of personality. *Journal of Psychosocial Research, 7,* 33-42.

Spielberger, C. D. (1989) *State-Trait Anxiety Inventory: Bibliography* (2nd ed.). Palo Alto, CA: Consulting Psychologists Press.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Spitzer, R. L., Kroenke, K., & Williams, J. B. W. (1999). Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. *Journal of the American Medical Association, 282,* 1737-1744. doi: 10.1001/jama.282.18.1737

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Lowe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine, 166*, 1092-1097.

Spreng, R. N., McKinnon, M. C., Mar, R. A., & Levine, B. (2009). The Toronto Empathy Questionnaire: Scale development and initial validation of a factor-analytic solution to multiple empathy measures. *Journal of Personality Assessment, 91,* 62-71. doi: 10.1080/00223890802484381.

Srivastava, A., & Tiwari, R. K. (2013). Role of social media on psychological well-being of adolescents. *Indian Journal of Health and Wellbeing, 4,* 919-922.

Srivastava, P., & Srinivasan, N. (2010). Time course of visual attention with emotional faces. *Attention, Perception & Psychophysics, 72*, 369-377. doi: 10.3758/APP.72.2.369

Stamenkovic, I., Dukic, T., & Aleksic, D. (2018). The phenomenon of media multitasking in the digital media era. *Facta Universitatis, 2,* 71-83. doi: https://doi.org/10.22190/FUTLTE1801071S.

Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin, 134,* 138-161. doi: 10.1037/0033-2909.134.1.138.

Suslow, T., Dannlowski, U., Lalee-Mentzel, J., Donges, U. S., Arolt, V., & Kersting, A. (2004). Spatial processing of facial emotion in patients with unipolar depression: a longitudinal study. *Journal of Affective Disorders, 83*, 59-63. doi: 10.1016/j.jad.2004.03.003

Suslow, T., Junghanns, K., & Arolt, V. (2001). Detection of facial expressions of emotions in depression. *Perceptual and Motor Skills, 92*, 857-868.

Sutton, T. M., & Altarriba, J. (2011). The automatic activation and perception of emotion in word processing: Evidence from a modified dot probe paradigm. *Journal of Cognitive Psychology, 23,* 736-747.

Taatgen, N. A., Juvina, I., Schipper, M., Borst, J. P., & Martens, S. (2009). Too much control can hurt: A threaded cognition model of the attentional blink. *Cognitive Psychology,* doi: 10.1016/j.cogpsych.2008.12.002.

Toepoel, V. (2013). Ageing, leisure, and social connectedness: How could leisure help reduce social isolation of older people? *Social Indicators Research, 113,* 355-372. doi: 10.1007/s11205-012-0097-6

Tottenham, N., et al. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research, 168,* 242-249.

Townshend, J. M., & Duka, T. (2001). Attentional bias associated with alcohol cues: Differences between heavy and occasional social drinkers. *Psychopharmacology, 157,* 67-74. doi: 10.1007/s002130100764.

Tran, U. S., Lamplmayr, E., Pintzinger, N. M., & Pfabigan, D. M. (2013). Happy and angry faces: Subclinical levels of anxiety are differentially related to attentional biases in men and women. *Journal of Research in Personality, 47*, 390-397. doi: 10.1016/j.jrp.2013.03.007

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology, 12*, 97-136.

Tritt, S. M., Ryder, A. G., Ring, A. J., & Pincus, A. L. (2009). Pathological narcissism and the depressive temperament. *Journal of Affective Disorders.* doi: 10.1016/j.jad.2009.09.006.

Trussler, M., & Soroka, S. (2014). Consumer demand for cynical and negative news frames. *The International Journal of Press/Politics, 19,* 360-379. doi: 10.1177/1940161214524832.

Uchino, B. N., Cacioppo, J. T., & Kiecolt-Glaser, J. K. (1996). The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin, 119,* 488-531. doi: 10.1037/0033-2909.119.3.488.

Uhls, Y. T., Michikyan, M., Morris, J., Garcia, D., Small, G. W., Zgourou, E., et al. (2014). Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. *Computers in Human Behaviour, 39,* 387-392. doi: 10.1016/j.chb.2014.05.036

Uncapher, M. R., Thieu, M., & Wagner, A. D. (2016). Media multitasking and memory: Differences in working memory and long-term memory. *Psychonomic Bulletin Review, 23,* 483-490. doi: 10.3758/s13423-015-0907-3.

Unsworth N, Heitz RP, Schrock JC, Engle RW (2005) An automated version of the operation span task. Behav Res Methods 37: 498–505.

van Dam, N. T., Earleywine, M., & Altarriba, J. (2012). Anxiety attenuates awareness of emotional faces during rapid serial visual presentation. *Emotion, 12*, 796-806. doi: 10.1037/a0024648

van der Shuur, W., Baumgartner, S., Sumter, S. R., & Valkenburg, P. M. (2015). The consequences of media multitasking for youth: A review. *Computers in Human Behavior, 53,* 204-215. doi: 10.1016/j.chb.2015.06.035.

Vanden Abeele, M. M. P., Antheunis, M. L., & Schouten, A. P. (2016). The effect of mobile messaging during a conversation on impression formation and interaction quality. *Computers in Human Behavior, 62,* 562-569. doi: 10.1016/j.chb.2016.04.005.

Vassilopoulous, S. P. (2005). Social anxiety and the vigilance-avoidance pattern of attentional processing. *Behavioural and Cognitive Psychotherapy, 33,* 13-24. doi:10.1017/S1352465804001730.

Verghese, P. (2001). Visual search and attention: A signal detection theory approach. *Neuron, 31,* 523-535. doi: 10.1016/S0896-6273(01)00392-0.

Vermeulen, N. (2010). Current positive and negative affective states modulate attention: An attentional blink study. *Personality and Individual Differences, 49*, 542-545. doi: 10.1016/j.paid.2010.04.003

Vermeulen, N., Godefroid, J., & Mermillod, M. (2009). Emotional modulation of attention: fear increases but disgust reduces the attentional blink. *PLoS One, 4*, e7924. doi: 10.1371/journal.pone.0007924

Visser, T. A. W., Bischof, W. F., & Di Lollo, V. (1999). Attentional switching in spatial and non-spatial domains: Evidence from the attentional blink. *Psychological Bulletin, 125*, 458–469.

Voorveld, H. A. M., & van der Goot, M. (2013). Media multitasking across age groups: A diary study. *Journal of Broadcasting & Electronic Media, 57,* 392-408. doi: 10.1080/08838151.2013.816709.

Vreeke, L. J., & Muris, P. (2012). Relations between behavioural inhibition, Big Five personality factors, and anxiety disorder symptoms in non-clinical and clinically anxious children. *Child Psychiatry and Human Development.* doi: 10.1007/s10578-012-0302-5.

Wang, J., Jackson, L. A., Gaskin, J., & Wang, H. (2014). The effects of Social Networking Site (SNS) use on college students' friendship and well-being. *Computers in Human Behaviour, 37,* 229-236. Doi: 10.1016/j.chb.2014.04.051

Wang, X., Xie, X., Wang, Y., & Lei, L. (2017). Partner phubbing and depression among married Chinese adults: The roles of relationship satisfaction and relationship length. *Personality and Individual Differences, 110,* 12-17. doi: http://dx.doi.org/10.1016/j.paid.2017.01.014.

Washburn, J. J., McMahon, S. D., King, C. A., Reinecke, M. A., & Silver, C. (2004). Narcissistic features in young adolescents: Relations to aggression and internalizing symptoms. *Journal of Youth and Adolescence, 33,* 247-260. doi: http://dx.doi.org/10.1023/B;JOYO.0000025323.94929.s9.

Watson, P. J., & Morris, R. J. (1991). Narcissism, empathy and social desirability. *Personality and Individual Differences, 12(6),* 575-579.

Watson, P. J., Sawrie, S. M., Greene, R. L., & Arredondo, R. (2002). Narcissism and depression: MMPI-2 evidence for the continuum hypothesis in clinical samples. *Journal of Personality Assessment, 79,* 85-109.

Weidman, A. C., Fernandez, K. C., Levinson, C. A., Augustine, A. A., Larsen, R. J., & Rodebaugh, T. L. (2012). Compensatory internet use among individuals higher in social anxiety and its implications for well-being. *Personality and Individual Differences, 53,* 191-195. doi: 10.1016/j.paid.2012.03.003

Weiser, E. B. (2000). Gender differences in internet use patterns and internet application preferences: A two-sample comparison. *Cyberpsychology & Behaviour, 3,* 167-178. doi: 10.1089/109493100316012

White, S. F., et al. (2012). Reduced amygdala response in youths with disruptive behaviour disorders and psychopathic traits: Decreased emotional response versus increased top-down attention to nonemotional features. *American Journal of Psychiatry, 169,* 750-758.

Wilhelm, O., Hildebrandt, A., Manske, K., Schacht, A., Sommer, W. (2014). Test battery for measuring the perception and recognition of facial expressions of emotion. *Frontiers in Psychology, 5,* doi: 10.3389/fpsyg.2014.00404.

Williams, J. M. G., Watts, F. N., Macleod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders.* Chichester, UK: Wiley.

Williams, M. O., Mathews, A., & Hirsch, C. R. (2014). Verbal worry facilitates attention to threat in high-worriers. *Journal of Behavioural Therapy & Experimental Psychiatry, 45,* 8-14.

Wisco, B. E., Treat, T. A., & Hollingworth, A. (2012). Visual attention to emotion in depression: facilitation and withdrawal processes. *Cognition and Emotion, 26*, 602-614. doi: 10.1080/02699931.2011.595392

Wolfe, J. M., Cave, K. R., & Franzel, S. L. (1989). Guided search: An alternative to the feature integration model for visual search. *Journal of Experimental Psychology: Human Perception and Performance, 15,* 419-433. doi: 10.1037/0096-1523.15.3.419.

Xu, S., Wang, Z., & David, P. (2016). Media multitasking and well-being of university students. *Computers in Human Behaviour, 55,* 242-250. doi: 10.1016/j.chb.2015.08.040

Yang, X., Xu, X., & Zhu, L. (2015). Media multitasking and psychological wellbeing in Chinese adolescents: Time management as a moderator. *Computers in Human*

Behavior, 53, 216-222. doi: http://dx.doi.org/10.1016/j.chb.2015.06.034.

Yap, J. Y., & Lim, S. W. H. (2013). Media multitasking predicts unitary versus splitting visual focal attention. *Journal of Cognitive Psychology, 25*, 889-902. doi: 10.1080/20445911.2013.835315

Yerys, B. E., Ruiz, E., Strang, J., Sokoloff, J., Kenworthy, L., & Vaidya, C. J. (2013). Modulation of attentional blink with emotional faces in typical development and in autism spectrum disorders. *Journal of Child Psychology and Psychiatry, 54,* 636-643.

Yu, H., Li, S., Qian, M., Yang, P., Wang, X., Lin, M., & Yao, N. (2014). Time-course of attentional bias for positive social words in individuals with high and low social anxiety. *Behavioural and Cognitive Psychotherapy, 42*, 479-490. doi: 10.1017/S1352465813000398

APPENDIX A

Table A1. *List of 260 words rated in pilot study for Study 2*

abdomen	climate	gravel	metal	shoulder
academy	clips	guess	miffed	shout
address	coat	hate	mighty	sign
admire	comfort	hateful	mince	slap
adore	confirm	hatred	minute	slash
affront	connect	heated	miracle	smile
agitate	content	heating	mirror	smoke
algebra	cordial	hell	mirth	solar
alive	cosy	helmet	murder	spectrum
anchovy	crane	hobby	offend	spirited
annoyed	cream	holder	outrage	spite
apron	cross	horse	oven	sponsor
argue	cruel	hostile	oerjoy	square
armour	dazzle	huffy	oyster	stadium
article	defiant	humour	paddle	stamp
assemble	delight	husky	palm	steam
attack	detest	incensed	pants	steaming
awesome	digital	inspired	patrol	steel
barn	discuss	invent	peace	stoked
barrel	divine	irate	peanut	success
basement	dream	ire	peeved	sum

beaker	drew	irked	peevish	summary
bedding	ecstatic	irritate	pension	supplier
bench	elated	jacket	pepper	supply
betray	energy	jolly	perform	swap
binder	enjoy	journey	pigskin	swing
bitter	enraged	jovial	plaster	tail
blessed	episode	joyful	pleased	tantrum
bliss	eternal	juice	positive	temper
boiling	exalted	jump	pouch	tense
border	excel	jungle	proud	terror
bottle	excited	kernel	provoke	thrilled
brave	explode	kidney	quibble	thrive
bread	eyebrow	kill	radiant	tonight
bright	field	knee	rage	towel
brochure	fiery	knob	range	tractor
bubbly	fight	laugh	rant	trim
bunch	flour	lavender	read	umbrage
canvas	flute	leather	resent	upset
carbon	freedom	lively	revived	uptight
carpet	frenzy	livid	revolt	vexed
carrier	fuming	love	riled	vibrant
carrot	funny	lucky	ripple	vigor
champ	furious	lyric	robot	violent
chaotic	fury	mad	scorn	vitality

charm	giggle	mallet	scream	warm
chart	glad	manage	script	western
cheer	glee	map	scrub	winter
cheerful	glow	marginal	seething	wired
cherries	grain	marinade	shape	wrath
chlorine	grammar	meal	shawl	zest
cleaner	grass	merry	shirt	zipper

Table A2. *List of 195 words rated in Study 2 following pilot study*

abdomen	cream	hell	overjoy	spirited
academy	cruel	helmet	paddle	spite
address	dazzle	holder	patrol	sponsor
admire	defiant	hostile	peace	square
adore	delight	huffy	peanut	stadium
affront	detest	humour	peeved	stamp
agitate	divine	inspired	pension	steam
alive	dream	irate	pepper	steel
annoyed	drew	irked	pigskin	success
argue	ecstatic	irritate	plaster	sum
attack	elated	jacket	pleased	summary
awesome	energy	jolly	positive	supplier
barn	enjoy	jovial	pouch	supply
barrel	enraged	joyful	proud	swap
basement	exalted	kernel	provoke	tail

betray	excel	kidney	radiant	tantrum
binder	excited	kill	rage	temper
bitter	explode	knee	ranch	tense
blessed	eyebrow	knob	rant	terror
bliss	field	laugh	resent	thrilled
boiling	fiery	lively	revolt	thrive
border	fight	livid	riled	tonight
brave	flour	love	ripple	towel
bread	freedom	lucky	robot	tractor
bright	fuming	lyric	scorn	trim
bubbly	funny	mad	scream	upset
carbon	furious	mallet	script	uptight
carpet	fury	map	seething	vexed
carrier	giggle	marginal	shape	vibrant
champ	glad	merry	shawl	vigor
charm	glee	metal	shirt	violent
chart	glow	mince	shoulder	vitality
cheer	grain	minute	shout	warm
cheerful	guess	miracle	shout	western
clips	hate	mirror	sign	winter
coat	hateful	murder	slap	wired
comfort	hatred	offend	smile	wrath
cosy	heated	outrage	solar	zest
crane	heating	oven	spectrum	zipper

APPENDIX B

Table B1. *ANOVA results for dot-probe face task (RT)*

	F	*p*
Between groups	2.49	.09
Condition	.93	.46
Time	19.48	< .001
Condition*group	1.77	.06
Time*group	.07	.94
Condition*time	1.07	.37
Condition*time*group	1.01	.43

Table B2. *ANOVA results for dot-probe face task (error rates)*

	F	*p*
Between groups	.68	.51
Condition	2.31	.05
Time	.37	.54
Condition*group	1.48	.14
Time*group	.35	.71
Condition*time	.29	.92
Condition*time*group	1.11	.35

Table B3. *ANOVA results for dot-probe word task (RT)*

	F	*p*
Between groups	2.09	.13
Condition	2.75	.02
Time	48.41	< .001
Condition*group	.94	.49
Time*group	.80	.45
Condition*time	.58	.69
Condition*time*group	.83	.58

Table B4. *ANOVA results for dot-probe word task (error rates)*

	F	*p*
Between groups	.36	.70
Condition	.88	.49
Time	.01	.91
Condition*group	.82	.60
Time*group	.93	.40
Condition*time	2.08	.07
Condition*time*group	.87	.56

Table B5. *ANCOVA results for dot-probe face task controlling for trait depression and trait anxiety (RT)*

	F	*p*
Between groups	2.49	.09
Condition	2.89	.01
Time	.44	.51
Condition*group	1.83	.05
Time*group	.09	.91
Condition*time	1.09	.36
Condition*time*group	1.03	.42

Table B6. *ANCOVA results for dot-probe face task (error rates) controlling for trait depression and trait anxiety*

	F	*p*
Between groups	.70	.50
Condition	.97	.44
Time	2.62	.11
Condition*group	1.47	.15
Time*group	.17	.85
Condition*time	1.09	.37
Condition*time*group	.95	.49

Table B7. *ANCOVA results for dot-probe word task controlling for trait depression and trait anxiety (RT)*

	F	*p*
Between groups	2.03	.14
Condition	2.56	.03
Time	3.68	.06
Condition*group	1.05	.40
Time*group	.69	.50
Condition*time	.42	.81
Condition*time*group	.83	.58

Table B8. *ANCOVA results for dot-probe word task (error rates) controlling for trait depression and trait anxiety*

	F	*p*
Between groups	.35	.71
Condition	.17	.97
Time	2.49	.12
Condition*group	.82	.61
Time*group	.83	.44
Condition*time	.88	.49
Condition*time*group	.88	.55

APPENDIX C

Table C.1. *ANOVA results for visual search face task (search time)*

	F	*p*
Between groups	.51	.60
Condition	501.48	< .001
Array	758.58	< .001
Condition*group	.64	.58
Array*group	.29	.78
Condition*array	242.68	< .001
Condition*array*group	.52	.78

Table C.2. *ANOVA results for visual search face task (error rates)*

	F	*p*
Between groups	.06	.94
Condition	96.69	< .001
Array	39.62	< .001
Condition*group	.34	.82
Array*group	.33	.84
Condition*array	10.18	< .001
Condition*array*group	.69	.72

Table C.3. *ANOVA results for visual word search task (search time)*

	F	*p*
Between groups	.45	.64
Condition	471.71	< .001
Array	994.39	< .001
Condition*group	1.40	.25
Array*group	.73	.51
Condition*array	313.01	< .001
Condition*array*group	1.72	.11

Table C.4. *ANOVA results for visual search word task (error rates)*

	F	*p*
Between groups	.21	.81
Condition	100.94	< .001
Array	29.21	< .001
Condition*group	.97	.41
Array*group	.56	.69
Condition*array	5.24	< .001
Condition*array*group	.51	.87

Table C.5. *ANCOVA results for visual search face task controlling for trait depression and trait anxiety (search time)*

	F	*p*
Between groups	1.86	.18
Condition	16.60	< .001
Array	21.87	< .001
Condition*group	.60	.61
Array*group	.29	.78
Condition*array	6.16	.001
Condition*array*group	.48	.81

Table C.6. *ANCOVA results for visual search face task (error rates) controlling for trait depression and trait anxiety*

	F	*p*
Between groups	.04	.97
Condition	1.42	.24
Array	6.29	.004
Condition*group	.24	.90
Array*group	.30	.85
Condition*array	2.93	.02
Condition*array*group	.72	.69

Table C.7. *ANCOVA results for visual search word task controlling for trait depression and trait anxiety (search time)*

	F	*p*
Between groups	.41	.67
Condition	21.42	< .001
Array	37.19	< .001
Condition*group	1.47	.22
Array*group	.67	.54
Condition*array	9.84	< .001
Condition*array*group	1.65	.12

Table C.8. *ANCOVA results for visual search word task (error rates) controlling for trait depression and trait anxiety*

	F	*p*
Between groups	.32	.73
Condition	1.85	.17
Array	1.17	.31
Condition*group	1.05	.38
Array*group	.62	.65
Condition*array	1.25	.29
Condition*array*group	.52	.87

APPENDIX D

Table D1. *ANOVA results for AB face task (T1 and T2 correct)*

	F	*p*
Between groups	.59	.56
Target type	74.64	< .001
SOA	403.56	< .001
Target combination	16.13	< .001
Target type*group	.03	.97
SOA*group	.16	.91
Combination*group	.64	.67
Target type*SOA	8.52	.001
Target type*combination	37.76	< .001
SOA*combination	14.44	< .001
Target type*SOA*combination*group	.98	.46

Table D.2. *ANOVA results for AB word task (T1 and T2 correct)*

	F	*p*
Between groups	1.27	.29
Target type	107.14	< .001
SOA	115.26	< .001
Target combination	10.78	< .001
Target type*group	.11	.90
SOA*group	.54	.62
Combination*group	.86	.54
Target type*SOA	57.62	< .001
Target type*combination	15.29	< .001
SOA*combination	.33	.92
Target type*SOA*combination*group	1.51	.12

Table D.3. *ANCOVA results for AB face task controlling for trait depression and trait anxiety (T1 and T2 correct)*

	F	*p*
Between groups	.62	.54
Target type	11.54	.001
SOA	18.31	< .001
Target combination	.65	.57
Target type*group	.07	.93
SOA*group	.12	.94
Combination*group	.60	.71
Target type*SOA	4.12	.03
Target type*combination	1.21	.30
SOA*combination	1.50	.19
Target type*SOA*combination*group	1.02	.43

Table D.4. *ANCOVA results for AB word task controlling for trait depression and trait anxiety (T1 and T2 correct)*

	F	*p*
Between groups	1.27	.29
Target type	5.51	.02
SOA	1.61	.21
Target combination	.95	.43
Target type*group	.08	.92
SOA*group	.59	.59
Combination*group	.83	.56
Target type*SOA	2.38	.11
Target type*combination	1.60	.20
SOA*combination	1.86	.09
Target type*SOA*combination*group	1.46	.14

Table D5. *ANOVA results for AB face task (T2 correct when T1 correct)*

	F	*p*
Between groups	.58	.56
SOA	289.90	< .001
Target combination	22.53	< .001
SOA*group	.25	.85
Combination*group	.55	.77
SOA*combination	5.63	< .001
SOA*combination*group	.61	.82

Table D.6. *ANOVA results for AB word task (T2 correct when T1 correct)*

	F	*p*
Between groups	1.36	.26
SOA	109.42	< .001
Target combination	12.06	< .001
SOA*group	.62	.58
Combination*group	.92	.49
SOA*combination	.81	.56
SOA*combination*group	1.07	.39

Table D.7. *ANCOVA results for AB face task controlling for trait depression and trait anxiety (T2 correct when T1 correct)*

	F	*p*
Between groups	.57	.57
SOA	23.01	< .001
Target combination	3.78	.01
SOA*group	.24	.86
Combination*group	.60	.74
SOA*combination	.66	.67
SOA*combination*group	.67	.77

Table D.8. *ANCOVA results for AB word task controlling for trait depression and trait anxiety (T2 correct when T1 correct)*

	F	*p*
Between groups	.02	.88
SOA	1.41	.24
Target combination	1.04	.38
SOA*group	.39	.73
Combination*group	.71	.66
SOA*combination	1.71	.12
SOA*combination*group	.77	.67