



Faculty of Cognitive Sciences and Human Development

**THE RELATIONSHIP BETWEEN MEDIA MULTITASKING HABITS
AND WORKING MEMORY PERFORMANCE**

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**THE RELATIONSHIP BETWEEN MEDIA MULTITASKING HABITS AND
WORKING MEMORY PERFORMANCE**

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ABSTRACT

In today's digital era, media multitasking is particularly prevalent among younger demographics. This quantitative study examines the relationship between media multitasking habits and working memory performance among undergraduate students at Universiti Malaysia Sarawak (UNIMAS). A sample of forty (40) participants, equally distributed by gender, was recruited through convenience sampling. The Short Media Multitasking Measure (MMM-S) was used to assess media multitasking habits, while the Digit Span Task (DST) and Corsi Block-Tapping Test evaluated verbal and visuospatial working memory performance, respectively, recording total correct recall and total time taken. Pearson and Spearman Rank-Order Correlations were employed for data analysis. The results revealed a significant positive relationship between media multitasking habits and both verbal and visuospatial working memory performance, as evidenced by greater accuracy in recall but longer task completion time among the participants with higher media multitasking score. These findings highlight the nuanced effects of media multitasking on distinct aspects of working memory performance, addressing prior research inconsistencies and advancing understanding of its cognitive implications within an academic framework. The study's limitations include potential confounding variables, a small sample size, use of self-reported MMM-S, and reliance on DST and Corsi Block-Tapping Test. Future research should explore additional variables, employ larger and more diverse samples, supplement self-reports MMM-S with objective assessments, incorporate ecologically valid tasks, as well as consider alternative working memory performance assessments and neuroimaging techniques.

Keywords: *Media multitasking, Verbal working memory, Visuospatial working memory, University students*

ABSTRAK

Dalam era digital, multitugas media lazim di antara demografi muda. Kajian kuantitatif ini meneliti hubungan antara tabiat multitugas media dan prestasi ingatan kerja di kalangan pelajar sarjana muda di Universiti Malaysia Sarawak (UNIMAS). Sampel terdiri daripada empat puluh (40) peserta, yang dibahagikan sama rata mengikut jantina, direkrut melalui pensampelan mudah. Short Media Multitasking Measure (MMM-S) digunakan untuk menilai tabiat multitugas media, manakala Digit Span Task (DST) dan Corsi Block-Tapping Test digunakan untuk menilai prestasi ingatan kerja lisan and keupayaan visuospatial, merekodkan jumlah ingatan yang betul dan masa yang diambil. Korelasi Pearson dan Spearman Rank-Order digunakan untuk analisis data. Hasil kajian menunjukkan hubungan positif yang signifikan antara tabiat multitugas media dan prestasi ingatan kerja lisan dan keupayaan visuospatial, dengan ketepatan ingatan yang lebih tinggi tetapi masa penyelesaian tugas yang lebih lama di kalangan peserta dengan skor multitugas media yang lebih tinggi. Ini menonjolkan kesan kompleks multitugas media terhadap pelbagai aspek ingatan kerja, menangani ketidakselarasan dalam penyelidikan terdahulu dan meningkatkan pemahaman tentang implikasi kognitif dalam kerangka akademik. Keterbatasan kajian ini termasuk pengaruh pembolehubah perancu, saiz sampel yang kecil, penggunaan laporan sendiri MMM-S, dan kebergantungan kepada DST dan Corsi Block-Tapping Test untuk menilai prestasi ingatan kerja. Penyelidikan masa depan harus meneroka pembolehubah perancu, menggunakan sampel yang lebih besar dan pelbagai, melengkapi laporan sendiri MMM-S dengan penilaian objektif, menggabungkan tugas yang sah dari segi ekologi, serta mempertimbangkan penilaian prestasi ingatan kerja alternatif dan teknik pengimejan saraf.

Kata kunci: *Multitugas media, Ingatan kerja lisan, Ingatan kerja keupayaan visuospatial, Pelajar universiti*

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter introduces the study on the relationship between media multitasking habits and working memory performance. It offers a comprehensive overview of the study's background and problem statement, highlighting its significance and relevance in psychology. Additionally, the chapter addresses existing research gaps identified from previous studies, outlines research objectives, hypotheses, and conceptual framework, and defines key terminologies.

1.1 Background of Study

The study focuses on analyzing the relationship between media multitasking and working memory performance in human subjects. In the hyper-connected digital age of continuous information exchange and pervasive digital media use, media multitasking has become a widely adopted skill. Media multitasking, defined as the simultaneous engagement with multiple media sources, has become increasingly common, especially among younger individuals (Matthews et al., 2022). This phenomenon, which has undeniably provided unlimited access to information, knowledge, and entertainment, raises concern regarding its effects on working memory performance. Working memory is commonly conceptualized as a mental space for temporarily storing and processing information. It comprises three subcomponents: verbal working memory (phonological loop), visual and spatial working memory (visuospatial sketchpad), and central executive (Baddeley, 2000; Baddeley & Hitch, 1974). It is important for various cognitive tasks, encompassing problem-solving, decision-making, learning, and reasoning (Dixon, 2022; Forsberg et al., 2021).

May and Elder (2018) emphasized the growing significance for university students to adeptly navigate a complex array of tasks, effortlessly switching between emails, social media, streaming content, and academic-related activities on a daily basis. Research has demonstrated that media multitasking significantly impacts working memory performance. Uncapher et al. (2016) found reduced working memory performance among individuals extensively engaged in media multitasking, regardless of external distractions. Conversely, Murphy and Creux (2021) posited that the effect of media multitasking on working memory performance is complex, suggesting that while media multitasking may enhance some aspects, such as capacity and processing speed, it can also impede others, namely inhibition performance. Working memory performance may be affected by a combination of these factors, resulting in an intricate interplay with the pros and cons of media multitasking.

Comprehending the research topic gains significance as media multitasking becomes more widespread. The present-day educational environment becomes more saturated with various forms of media causing students' ability to manage multiple media streams concurrently to be seen as an essential skill. However, the extent to which media multitasking affects working memory performance remains a matter of debate among scholars. Consequently, additional research is required on the research topic, specifically in examining the influences of media multitasking habits on working memory performance, with a main emphasis on Universiti Malaysia Sarawak (UNIMAS) students as the target population in this present research. It will primarily focus on measuring and comparing participants' scores in the Digit Span Task (DST) and the Corsi Block-Tapping Test, which assess verbal and visuospatial working memory performance, respectively, based on measures of total correct recall and total time taken.

1.2 Problem Statement

Despite the widespread practice of media multitasking worldwide, there is a notable lack of empirical studies that thoroughly investigate its precise effects on working memory performance. The phenomenon of media multitasking has become omnipresent in today's society, but its specific cognitive effects, particularly on working memory, remain inadequately comprehended. In light of the increasing incorporation of digital media into our daily routines, it is imperative to examine how media multitasking affects cognitive functions, particularly working memory performance. Working memory plays a key role in learning, problem-solving, and decision-making (Chai et al., 2018; Cowan, 2015), underscores the importance of understanding how media multitasking influences working memory performance, thereby elucidating its broader effects on cognitive functioning. The lack of empirical research in this specific domain presents an apparent challenge, as it hinders the ability to provide evidence-driven perspectives on the research topic.

A thorough examination of existing literature reveals a mix of both converging and diverging results and findings concerning media multitasking and its association with working memory performance. This underscores a substantial void in research and highlights the need for additional research on the topic. Research has predominantly concentrated on two main aspects of media multitasking on working memory performance: 1) the negative consequences (Moisala et al., 2016; Ralph & Smilek, 2017), and 2) the potential advantages and mitigating factors (Alzahabi et al., 2017), therefore resulting in a lack of a holistic perspective in understanding the exact impacts of media multitasking on working memory performance.

Besides that, the major focus of past studies revolves around adolescents and teenagers as the target population (Cain et al., 2016; Uncapher & Wagner, 2018). Thus, it can be inferred that

there exists a scarcity of studies pertaining to this specific area of research among the demographic of university students. In actuality, the investigation into the topic deserves increased focus among university students, who are commonly described as avid users of digital media and technology and are very susceptible to the potential consequences of excessive engagement in media multitasking habits.

A significant knowledge deficit exists in comprehending the research topic across different cultural settings. Most research on media multitasking has primarily emphasized Western nations. Research findings indicate that American youths devote an average of 7.5 hours daily to interacting with digital media, exceeding the duration of any other waking activities, and around 29% of this time is dedicated to media multitasking (Uncapher et al., 2017). In Asian countries, similar research has mainly focused on those in East Asia (Bowman et al., 2014). Subsequently, a discernible lack of research studies encompassing Malaysian participants becomes apparent.

1.3 Research Objectives

1.3.1 General Objectives

The purpose of this study is to identify the relationship between media multitasking habits and working memory performance.

1.3.2 Specific Objectives

- a) To identify the relationship between media multitasking habits and verbal working memory performance based on the total correct recall.
- b) To identify the relationship between media multitasking habits and verbal working memory performance based on the total time taken.

- c) To identify the relationship between media multitasking habits and visuospatial working memory performance based on the total correct recall.
- d) To identify the relationship between media multitasking habits and visuospatial working memory performance based on the total time taken.

1.4 Research Questions

- a) Is there any significant relationship between media multitasking habits and verbal working memory performance based on the total correct recall?
- b) Is there any significant relationship between media multitasking habits and verbal working memory performance based on the total time taken?
- c) Is there any significant relationship between media multitasking habits and visuospatial working memory performance based on the total correct recall?
- d) Is there any significant relationship between media multitasking habits and visuospatial working memory performance based on the total time taken?

1.5 Research Hypotheses

- H₁: There is no significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.
- H₂: There is no significant relationship between media multitasking habits and verbal working memory performance based on total time taken.
- H₃: There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.

H₄: There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.

1.6 Conceptual Framework

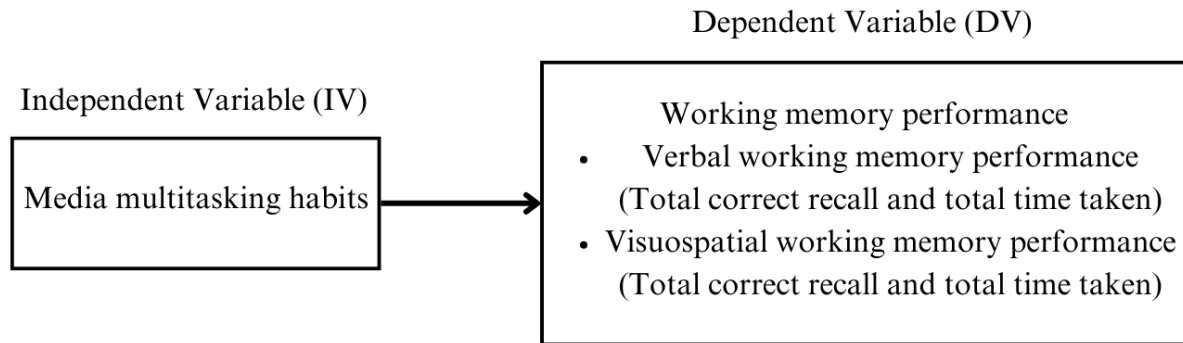


Figure 1.6: *Conceptual Framework on the Relationship Between Media Multitasking Habits and Working Memory Performance*

The conceptual framework illustrated in Figure 1.6 has been constructed through a comprehensive examination of relevant literature, which has revealed the significance of media multitasking habits in exploring the relationship between media multitasking and working memory performance. It serves as a fundamental framework for organizing and advancing ongoing research while also aiding the identification and analysis of areas that require further exploration. Additionally, this framework is also employed in formulating the hypothesis. In this study, the media multitasking habits of each participant is identified as the independent variable (IV) and working memory performance is the dependent variable (DV), specifically measuring verbal and visuospatial working memory performance based on total correct recall and total time taken.

1.7 Significance of Study

This study aims to investigate the relationship between media multitasking and working memory performance among students at Universiti Malaysia Sarawak (UNIMAS). Understanding this relationship holds great significance for the increasingly digitalized world. The findings have the potential to enhance the comprehension of how media multitasking habits affect working memory performance among UNIMAS students and help resolve the inconsistencies shown in prior studies, which have shown both negative and positive impacts of media multitasking on working memory. By determining whether university students' media multitasking habits has beneficial or detrimental effects on their working memory performance, this study seeks to establish a meaningful relationship between the two variables. Additionally, the research findings could provide valuable insights for university students, enabling them to make informed decisions on media multitasking habits for academic purposes, as well as for educators to optimize the learning environments during lectures.

1.8 Scope of Study

The study intends to determine the extent to which media multitasking habits influence working memory performance among participants. A convenience sampling technique was employed to recruit 40 undergraduate students from Universiti Malaysia Sarawak (UNIMAS). Ethical considerations are adhered to by acquiring informed consent from all participants to ensure they are fully aware of the nature and objectives of the research. Likewise, all data collected will be strictly confidential and used solely for the purposes of this research.

1.9 Definition of Terms

1.9.1 Media Multitasking

Conceptual Definition: Media multitasking refers to the act of engaging in many forms of tasks simultaneously, with at least one of them being a media-related task (Beuckels et al., 2021). It generally entails the quick and frequent shifting of attention between various sources of media (Foehr, 2006; May & Elder, 2018), and is categorized as the management of numerous channels of information, communication, or entertainment, typically facilitated by the utilization of electronic gadgets (Domoff et al., 2020).

Operational Definition: Media multitasking in this study refers to the procedures or measures employed to determine the media multitasking habits of the participants recruited from Universiti Malaysia Sarawak (UNIMAS), which was assessed through the implementation of a survey-based methodology known as the Short Media Multitasking Measure (MMM-S), developed by Baumgartner et al. (2017).

1.9.2 Working Memory

Conceptual Definition: Working memory refers to a cognitive mechanism that allows for temporary storage and manipulation of information necessary for the execution of cognitive tasks, utilizing its various components, namely the central executive, the phonological loop, and the visuospatial sketchpad to effectively retain and process information over limited durations (Baddeley & Hitch, 1974).

Operational Definition: Working memory in this study refers to the procedures and measures employed to evaluate the working memory performance of the participants based on total correct recall and total time taken. The Digit Span Task (DST), developed by Orsini et al. (1987), was utilized to assess verbal working memory performance, while the Corsi Block-Tapping Test, developed by Kessels et al. (2000), was utilized to evaluate visuospatial working memory performance.

1.10 Summary

The chapter offers a comprehensive overview of the research topic, elucidating the prevalence of media multitasking habits among university students. It underscores the importance of investigating working memory performance as a critical aspect of cognition and explores the current body of literature, which revealed contradicting and inconsistent results. Furthermore, it is also noteworthy that there continues to be inadequate research contributions targeting the population of university students in Malaysia. Thus, this study seeks to explore the complex connection between media multitasking and working memory performance, aiming to enhance the understanding of the cognitive impacts of media multitasking and presenting significant perspectives for optimizing the cognitive abilities of university students in the present era of digital technology.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provides a brief and concise overview of the core concepts, theories, and empirical findings and discoveries on the relationship between media multitasking and working memory performance. It aims to conduct a thorough analysis of the existing body of research on the topic, considering both the potential advantages and disadvantages of media multitasking on working memory performance. The main purpose is to build a strong basis for understanding the research topic, pinpoint existing research gaps that necessitate further investigation, as well as lay the groundwork for an in-depth examination of the topic.

2.1 Media Multitasking

Media multitasking, as defined by Beuckels et al. (2021) and Drodry et al. (2023), refers to the practice of simultaneously engaging in various tasks, with at least one of them involving a type of media. It corresponds to the rapid and frequent switching of attention between different sources of media (Foehr, 2006; May & Elder, 2018), and involves managing multiple channels of information, communication, or entertainment, often facilitated by the use of digital gadgets (Domoff et al., 2020). The advancement and accessibility of technology have led to the widespread practice of media multitasking, establishing it as a prevailing norm or phenomenon. Voorveld and Goot (2013) discovered that individuals aged 13 to 65 allocate approximately 17 to 31% of their media time to engaging in media multitasking habits. Furthermore, Ralph et al. (2018) demonstrated that a large majority of the 164 university students who participated in a laboratory study opted to media multitask when presented with the option to do so, despite being fully aware

of its detrimental effects on their performance in the study. These statistics stress the widespread prevalence of media multitasking habits, especially among university students. This highlights the need for additional research into the potential impacts of media multitasking on cognitive processes, such as working memory, within higher education institutions.

2.1.1 Theory Related to Media Multitasking Habits

2.1.1.1 Cognitive Control Theory

Cognitive control theory, which is closely related to the concepts of attention control and executive function, involves processes aimed at establishing and maintaining appropriate task goals while inhibiting irrelevant ones. Moreover, it entails utilizing current goal representations to adjust attentional biases to enhance task performance (Gratton et al., 2017). The cognitive control mechanism seeks to elucidate how individuals regulate and control their cognitive processes to accommodate changing demands (Miller & Cohen, 2001, as cited in Dixon, 2015; Rand & Cohen, 2017), particularly in situations involving contradictory information or numerous tasks (Hirsch et al., 2018).

When investigating the relationship between media multitasking and working memory performance within the framework of Cognitive Control Theory, it is posited that the theory aims to comprehend how individuals effectively allocate their attention and cognitive resources when faced with competing stimuli or tasks, such as engaging with multiple media sources simultaneously. Another key aspect of the theory encompasses cognitive monitoring, which suggests that the human brain is continuously monitoring for discrepancies in information processing (Botvinick et al., 2001). This is especially relevant to the research topic as media multitasking implies individuals being exposed to conflicting stimuli, such as competing visual

and auditory cues, from different media sources, and thus, upon encountering contradictory cues, the cognitive control mechanism is triggered to resolve the conflict by determining the individual's attentional focus.

2.2 Working Memory Performance

Working memory is crucial for effectively handling the cognitive demands of concurrently engaging in multiple media tasks. Working memory performance, in essence, pertains to the ability of an individual to store and manipulate information in his/her working memory system efficiently and effectively. Due to the limited capacity of working memory, it can only retain a certain amount of information for a short duration (Cowan, 2015). This raises concerns about how individuals cope with the demands of media multitasking, as the competition for cognitive resources may affect their ability to efficiently retain and manipulate information.

Effective media multitasking relies on the individuals' ability to efficiently utilize their working memory, enabling them to distribute attention (Oberauer, 2019), process information from diverse media sources, and resist interference (Uncapher et al., 2016). Additionally, working memory performance is strongly linked to the ability to flexibly shift attention and cognitive resources between tasks, a cognitive function referred to as task switching (Ralph et al., 2013; Wang et al., 2022), which is particularly pertinent to the research topic since media multitasking necessitates individuals to seamlessly switch between multiple information sources and cognitive processes (Chris, 2023). Lastly, efficient working memory performance often involves a balance between speed and accuracy (Poll et al., 2013), indicating that individuals with high working memory performance can efficiently and accurately process and manipulate information. Overall, it underscores the primary importance of working memory performance in different cognitive processes, shedding light on its significance during media multitasking.

2.2.1 Theory Related to Working Memory Performance

2.2.1.1 Baddeley's Model of Working Memory

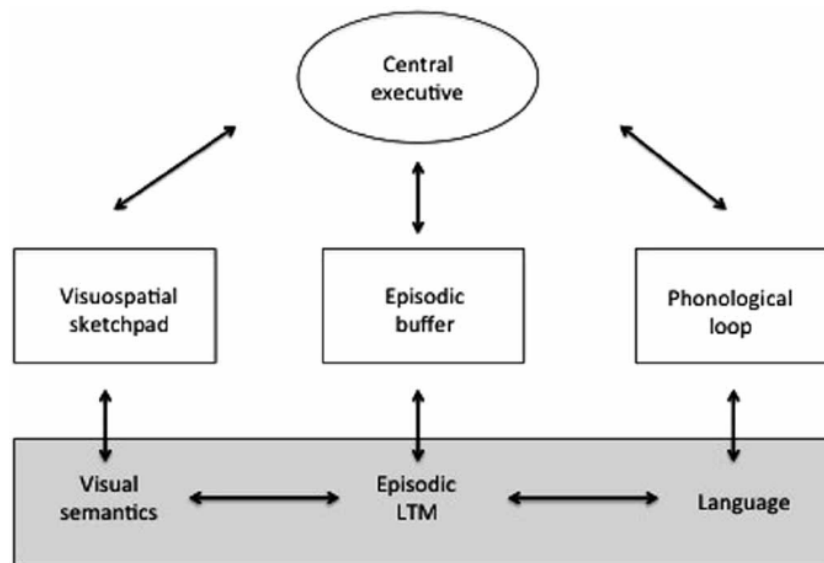


Figure 2.2.1.1: *Baddeley's Model of Working Memory*

Figure 2.2.1.1 shows Baddeley's Model of Working Memory (Baddeley, 2000, as cited in Banales et al., 2015). Working memory, defined by Baddeley and Hitch (1974), is a cognitive system that temporarily stores and manipulates information for the execution of cognitive tasks. The model examined three subcomponents of working memory, including 1) verbal working memory, known as the phonological loop, 2) visuospatial working memory or visuospatial sketchpad, and 3) the central executive. The phonological loop processes and stores speech-based information, consisting of the phonological store and subvocal rehearsal, while the visuospatial sketchpad handles visual and spatial information (Fang et al., 2020). The central executive functions as the main controller of the system, responsible for controlled processing in working memory (McCabe et al., 2010). It handles the manipulation, retention, and coordination of information between the other subcomponents, while also managing attention (Baddeley, 2000b,

as cited in Chai et al., 2018; Mcleod, 2023). The three constituent elements of working memory work together to efficiently retain and process information for a limited time. Baddeley (2000) later introduced the episodic buffer as a new component of working memory, which acts as a temporary storage system integrating various sensory information.

2.3 Previous Findings

2.3.1 Media Multitasking and Working Memory Performance

2.3.1.1 Inconsistency and Inconclusive Findings in Existing Body of Research

In light of the increasing prevalence of media multitasking, multiple studies have explored its correlation with working memory performance (Uncapher et al., 2016), revealing inconsistent and inconclusive findings in prior research. Currently, it remains unclear whether frequent media multitaskers perform are less proficient than infrequent media multitaskers. Alzahabi et al. (2017) discovered that media multitasking is linked to improved task preparation ability and hence resulting in faster task-switching performance, a cognitive process involved in assessing working memory performance. Importantly, this improved performance does not come at the expense of accuracy. In addition, research indicated that individuals who frequently engage in media multitasking outperform those who multitask less often in various cognitive areas, such as fluid intelligence, encompassing reasoning, problem-solving, and adapting to new situations (Minear et al., 2013), multisensory integration (Lui & Wong, 2012), and flexibility in allocating visual attention (Yap & Lim, 2013). These distinct cognitive functions often interact and impact one another, thereby enhancing working memory performance (Uncapher et al., 2016).

From a different standpoint, numerous studies have documented the adverse outcomes attributed to the engagement in media multitasking on working memory performance. Ophir et al.

(2009) demonstrated that heavy media multitaskers perform less effectively in various distractor-filtering tests compared to those who engage in less media multitasking. Similarly, Sanbonmatsu et al. (2013) found that heavy media multitaskers are more susceptible to distraction from external stimuli. Other than that, in a study conducted by Moisala et al. (2016), 149 adolescents and young adults, aged between 13 to 24 years, were examined. The results suggested that engaging in daily media multitasking is linked to behavioural distractibility, implying that heavy media multitaskers may experience difficulties in maintaining focused attention on a single task, and may require more cognitive resources to filter and process multiple information. Ralph and Smilek (2017) administered 2- and 3-back tests on a sample size of 201 participants, aged between 18 to 62 years. Their findings indicated that individuals who engage in frequent media multitasking are prone to interrupting or diverting their attention from ongoing tasks. Thus, there is a clear presence of research inconsistencies, which emphasizes the lack of consensus among studies addressing the relationship between media multitasking and working memory performance.

2.3.1.2 Scarcity of Research among University Students

In examining the correlation between media multitasking and working memory performance, much attention has been directed towards adolescents and teenagers as the primary target population. A notable study carried out by Cain et al. (2016) delved into individual variations within a cohort of adolescents and discovered substantial associations between regular engagement in media multitasking and various consequences. Their research highlighted a negative correlation between increased media multitasking and performance on statewide standardized achievement tests in Math and English. Furthermore, these individuals exhibited diminished or poorer working memory capacity in the controlled laboratory environment, alongside traits characterized by

greater impulsivity and a less growth-oriented mindset. Consequently, this led to a decline in working memory performance, affecting the effective utilization of working memory resources by causing difficulties in attention management or resistance to distractions (Cardoso-Leite et al., 2021; Ralph et al., 2013) as well as increased proneness to errors (Ophir et al., 2009).

Extending research to university students is crucial to fully comprehend the correlation between media multitasking habits and working memory performance. Given their high engagement with digital media and technology, coupled with their vulnerability to the potential repercussions of excessive involvement in media multitasking behaviours, university students represent a distinct and pertinent group for this study. Additionally, the present study aims to refocus attention on the utilization of working memory performance tests in this context.

2.3.2 Different Methodologies in Past Research

The existing body of research indicates a widespread use of comparative and experimental research methodologies. For instance, Uncapher et al. (2016) conducted experimental research with 139 participants aged 18 to 35 years, categorizing them into heavy media multitaskers (HMMs) and light media multitaskers (LMMs) based on their Media Multitasking Index (MMI). The study revealed that LMMs are better at retaining task-relevant information compared to HMMs due to the higher tendency of those in HMMs to perceive a change even when none occurred. In general, it was deduced that HMMs exhibited diminished working memory performance, irrespective of the presence or absence of external distractions. Furthermore, another experimental research carried out by Imren and Tekman (2019) demonstrated that while media multitasking might enhance working memory performance, it also impedes the ability to sustain

attention. These findings support ideas related to limited cognitive capacity, the allocation of multiple resources, and neural plasticity.

In contrast, the current study diverges in methodology by not grouping participants into separate groups of HMMs and LMMs. Instead, it examines the continuum of media multitasking habits without dichotomous categorization, providing a more comprehensive understanding of the correlation between media multitasking and working memory performance. This approach acknowledges the complexity of this relationship, as highlighted by varied methodologies employed in previous research.

2.3.3 Media Multitasking in Western and Asian Contexts

Additionally, multiple research relevant to the research topic of interest has primarily concentrated on Western nations. For instance, Uncapher et al. (2017) conducted a study to investigate the media multitasking habits of Western individuals, such as those in the United States and Israel, emphasizing the importance of addressing the potential negative effects of media multitasking on students' academic performance. Moreover, the authors claimed that media multitasking can impede the learning process in a classroom setting, resulting in reduced learning outcomes for college students due to attention being divided and difficulty focusing. In relation to the context of Malaysia, Bowman et al. (2014) contended that Asian countries have embraced electronic media to the same extent as Western societies, and therefore, their research focuses on comparing media multitasking in American and Malaysian college students. The study, involving 597 college students (238 Americans and 359 Malaysians), revealed that Malaysians displayed higher levels of electronic media consumption and greater media multitasking habits compared to Americans, but also highlights higher levels of distractibility and impulsiveness. Overall, the

existing literature underscores the importance of continuous research on the topic of media multitasking and working memory performance within the context of Malaysian university students.

2.4 Improvement in the Present Study

2.4.1 Methodological Advancements

The methodological advancement in this present study lies in the deviation from the conventional approach of categorizing participants into distinct groups of heavy media multitaskers (HMMs) and light media multitaskers (LMMs). For example, Murphy and Creux (2021) explored the correlation between media multitasking and performance on tasks related to working memory and inhibition. The researchers used Media Multitasking Index (MMI) to separate the participants into two groups of HMMs and LMMs, based on their media multitasking behaviours, and assessed their working memory with the Digit Ordering Task, their inhibition with the Spatial Stroop Task, and both working memory and inhibition with the Go/No-Go task under low and high task loads. Instead, this research adopts a more sophisticated approach, eschewing the dichotomous classification of media multitasking and opting for a continuum that accurately represents the natural variability in media multitasking behaviours observed in the participants. This revision in terms of the methodology used in this present study recognizes the intricate nature of media multitasking habits and provides a more precise representation of their possible influence on working memory performance.

Besides that, the current study attempts to broaden the range of working memory tests beyond a single test assessing the overall working memory performance. This includes the utilization of rectangles and objects tasks to evaluate the visual working memory performance of

the participants, as indicated by Uncapher et al. (2017). The research is grounded on the understanding that working memory is a complex cognitive function comprising distinct components, such as verbal and visuospatial aspects. By incorporating a variety of tasks that specifically assess the different components of working memory, it is possible to gain valuable insights into whether media multitasking impacts only specific facets or the overall performance of the working memory. Consequently, this study plays a role in enhancing the understanding of the relationship between media multitasking and the verbal and visuospatial components of working memory performance, thereby contributing to the methodological diversity in psychological research related to working memory.

2.4.2 Addressing a Cultural Gap

The inclusion of Malaysian university students, namely those from Universiti Malaysia Sarawak (UNIMAS), as the specific target demographic of this present study fills an identifiable void in the existing body of research. In contrast to prior studies that mostly concentrated on Western countries, the current study acknowledges the significance of cultural variety in comprehending the relationship between media multitasking and working memory performance, therefore ensuring that the research results and findings are not only derived from a Western-centric viewpoint but are instead applicable and pertinent to a global audience. Moreover, the involvement of Malaysian university students enhances the external validity of the study, hence increasing the generalizability of the findings beyond Western cultural contexts. The population choice reflects the diversity in media multitasking habits and cognitive functions associated with working memory performance across diverse cultural settings.

2.5 Summary

The literature review analyses the relationship between media multitasking habits and working memory performance. It unveiled a heterogeneous collection of evidence pertaining to the impacts of media multitasking on working memory performance, where some studies showed favourable outcomes, while others indicated either an absence of correlation or negative effects. Hence, the study aims to address these contradictory findings. Additionally, similar research on media multitasking and working memory performance has mainly focused on recruiting teenagers and adolescents as the primary demographic. Consequently, the current research seeks to fill this gap by investigating the relationship between media multitasking habits and both verbal and visuospatial working memory performance specifically among university students. Given the significance of acknowledging university students as a distinct group with specific challenges and demands on their working memory for their learning process, such as problem-solving, note-taking, and engaging in other academic-related tasks, conducting this correlational study among the student population at UNIMAS could yield valuable insights into the potential benefits or downsides of media-multitasking in this population.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter details the methodological framework for investigating the relationship between media multitasking and working memory performance among UNIMAS students. It covers the rationale underlying the research design, sampling procedures, and research instruments. Additionally, it discusses the possibility of conducting a pilot study, alongside a thorough review of the ethical considerations. Lastly, it addresses the data collection and analysis procedures.

3.1 Research Design

A quantitative approach was employed to explore the relationship between media multitasking habits and working memory performance. This approach was chosen for its suitability in testing hypotheses and assessing the attitudes and behaviours within a substantial population (Verhoef & Casebeer, 1997), such as the student population at UNIMAS. The research design utilized in this study is classified as a correlational study design, which examines the relationships between variables without the researcher manipulating them (Curtis et al., 2016) and the correlation can be either positive or negative in direction (Ahmad & Bujang, 2022). The variables under research were assessed using established tools such as the Short Media Multitasking Measure (MMM-S) (Baumgartner et al., 2017), Digit Span Task (DST) (Orsini et al., 1987), and Corsi Block-Tapping Test (Kessels et al., 2000).

3.2 Population, Sample, and Sampling Procedure

Bhandari (2020b) defines population as the complete set of individuals from which a researcher collects data for statistical analysis. On the other hand, a sample is a distinct subset of

the population that is utilized for collecting and computing statistics. In other words, the sample size is consistently smaller than the total population size. The main population of interest is identified to be the student population at Universiti Malaysia Sarawak (UNIMAS). Convenience sampling, a non-probability methodology, is employed to select participants based on their accessibility to the researcher (Nikolopoulou, 2022). The sample size consists of 40 participants.

3.3 Instruments

This study aims to examine the relationship between media multitasking habits and verbal and visuospatial working memory performance among UNIMAS students. The participants' working memory performance was assessed based on total correct recall and total time taken to complete the assigned tasks. Demographic information from respondents was gathered through a questionnaire administered via Google Forms.

3.3.1 Instrument Structure

Table 3.3.1: *Summary of Instruments Used*

Instruments	No. of Items	Cronbach Alpha Value (α)	Source
Short Media Multitasking Measure (MMM-S)	9	0.90	Baumgartner et al. (2017)
Digit Span Task (DST)	-	0.68 to 0.89	Gignac et al. (2017) Paula et al. (2016)
Corsi Block-Tapping Test	-	0.75	Paula et al. (2016)

3.3.1.1 Short Media Multitasking Measure (MMM-S)

The Short Media Multitasking Measure (MMM-S), developed by Baumgartner et al. (2017), was adopted in this study to quantify the media multitasking habits of the participants, by using a rating scale approach, where the 9 items are evaluated using a 4-point Likert scale, consisting of 1 (Never), 2 (Sometimes), 3 (Often), 4 (Very Often). The individual scores for each item are summed, and subsequently, averaged to obtain an overall score for each participant. The Cronbach alpha (α) for MMM-S is 0.90 in a sample of 2278 participants (Baumgartner et al., 2017), reflecting a high level of internal consistency among the items in the questionnaire and demonstrating its reliability in measuring media multitasking habits.

Table 3.3.1.1: *List of Items of the MMM-S (Baumgartner et al., 2017)*

1. While watching TV, how often do you engage in the following activities...
...listening to music
...sending messages via phone or computer
...using social networking sites
2. While using social network sites, how often do you engage in the following activities...
...listening to music
...sending messages via phone or computer
...watching TV
3. While sending messages via phone or computer, how often do you engage in the following activities...
...listening to music
...using social networking sites

3.3.1.2 Digit Span Task (DST)

Digit Span Task (DST), developed by Orsini et al. (1987), was adopted in this study to determine the participants' verbal working memory performance. DST, proposed by Miller (1956), aims to test an individual's capacity to perceive, analyse, and retain information. Presently, DST serves as a subtest within the Wechsler Adult Intelligence Scale (WAIS) to measure intelligence (Ruchinskis, 2019). Orsini et al. (1987) made some adjustments to the DST to adapt it for assessing verbal working memory performance, hence making it suitable to be utilized for this research. In this study, the participants were presented with a sequence of two digits and were instructed to recall and repeat the digits in the same sequence. They are required to retain this verbal information in their memory for a brief duration while manipulating it during the recalling process. The process is iterated with each trial, gradually increasing the length of the sequence, until the participants reach a point where they are unable to repeat the sequence anymore. The longest remembered sequence is the participant's digit span. The duration of each trial is recorded. The Cronbach alpha (α) for DST ranges from 0.68 to 0.89 (Gignac et al., 2017; Paula et al., 2016), indicating moderate and acceptable internal consistency. Moreover, the split-half reliability of DST is reported to be 0.76 (Kotlyusov et al., 2023). These findings imply that DST is a suitable tool for measuring the verbal working memory performance of adults, especially university students.

3.3.1.3 Corsi Block-Tapping Test

Corsi Block-Tapping Test, developed by Kessels et al. (2000), was adopted in this present study to measure the visuospatial working memory performance of the participants. The test was

named after its author, Philip Michael Corsi (1972), initially not intended to be a computer task. The researcher of this study utilized the digital version of this task, introduced by Kessels et al. (2000), where the participants were exposed to a sequence of two blocks. After the sequence is displayed on the screen, the participants are required to click on the blocks in the same order as previously shown. If the answer is correct, the participants will advance to the next level by completing a sequence with greater number of blocks. In contrast, if the participants provided incorrect answers, they were granted a second chance. If answered incorrectly again, the longest remembered sequence is the participant's Corsi block span. Paula et al. (2016) demonstrated that the task has a Cronbach alpha (α) of 0.75, which indicates a moderate to good level of consistency in measuring visuospatial working memory performance.

3.4 Pilot Study

Based on the definition provided by Simkus (2022), a pilot study is a preliminary and concise investigation undertaken at an early stage of the research project, which aids in the strategic planning and evaluation of the viability of a larger-scale study to be conducted in the near future. The advantages of conducting a pilot study include ensuring the accuracy and validity of the measuring instruments pertaining to the variables being tested (Simkus, 2022; Sundram & Romli, 2023). Notably, the sample size recommended for pilot testing ranges from 5 to 30 individuals (Hair et al., 2003; Sundram & Romli, 2023). In this research, a pilot study was conducted with a sample size of 6 participants to evaluate the suitability of the instruments for assessing Malaysian university students, particularly those from UNIMAS and to detect any potential concerns on its comprehension and relevance to the research topic.

Participants recruited for the pilot study represent various faculties at UNIMAS, comprising 3 individuals from the Faculty of Cognitive Sciences and Human Development (FCSHD), and 1 each from the Faculty of Economics and Business (FEB), Faculty of Medicine and Health Sciences (FMHS), and Faculty of Engineering (FENG). Among the 6 participants, one is a first-year student, while the remaining five are currently in their third year of study. Feedback garnered from the pilot study participants consistently affirmed the effectiveness of the adopted instruments, namely the Short Media Multitasking Measure (MMM-S), Digit Span Task (DST) and Corsi Block-Tapping Test, in accurately measuring the intended variables of the research. In addition, all participants confirmed the clarity of the questions and instructions, along with their understanding of the research objectives. However, it was noted by one of the participants that the website links provided for accessing the Digit Span Task (DST) and Corsi Block-Tapping Test were non-functional, causing the inconvenience of manual copying and pasting of the links into a separate browser tab. For this reason, the links were made clickable and easily accessible.

3.5 Ethics of the Study

The ethics of the study encompassed the researcher's adherence to principles and guidelines to guarantee the research is conducted ethically and responsibly. The primary ethical concerns of this study revolved around upholding the integrity of the research, while also prioritizing the rights, dignity, and well-being of the participants (Resnik, 2020). In this research, informed consent was provided to every participant to ensure that they were thoroughly informed about the study, including the potential risks and benefits associated with their involvement. Furthermore, confidentiality, denoting the moral duty to safeguard and maintain the privacy of the information acquired from the participants, was ensured by restricting access to the research data exclusively to the researcher team and implementing secure data storage protocols.

3.6 Data Collection Procedure

Convenience sampling is used as a method for selecting participants, who consented to take part in the current study, comprising UNIMAS students. Data collection was facilitated by using Google Forms, providing participants with easy access to respond comprehensively to the instruments encompassing Section A: Informed Consent Form, Section B: Demographic Information, Section C: Short Media Multitasking Measure (MMM-S), Section D: Digit Span Task (DST), and Section E: Corsi Block-Tapping Test. This approach enhances accessibility and convenience for both participants and researcher. The questionnaire was administered individually to a total of 40 participants. Participants were required to be present at the physical testing location to complete Digit Span Task (DST) and Corsi Block-Tapping Test to record the total correct recall and total time taken using Google Forms. After the desired number of participants was achieved, Google Sheets was utilized to efficiently organize the data. The media multitasking score of each participant is calculated by taking the average of the 9 items to construct a single mean index.

3.7 Data Analysis Procedure

3.7.1 Descriptive Statistics

Following the data collection process, the gathered data was analysed using statistical methods and SPSS software. The characteristics are analysed through the application of descriptive statistics, which encompasses numerical or graphical depictions of a dataset (Bhandari, 2020a). Descriptive statistics is used to examine the mean of media multitasking habits and working memory performance among the sample of university students at UNIMAS. Additionally, it provides the standard deviation, which aids in describing the extent of variability in both media multitasking habits and working memory performance scores among the participants.

3.7.2 Inferential Statistics

Inferential statistics were computed using Pearson correlation and Spearman Rank-Order Correlation to explore the relationship between media multitasking and working memory performance. In this context, the Pearson and Spearman correlation coefficient can be employed to quantify the strength and direction of the linear association between media multitasking habits and working memory performance, particularly verbal and visuospatial working memory performance. The correlation coefficient, denoted as r , can be interpreted as follows: when $r > 0$, it signifies a positive correlation; when $r < 0$, it suggests a negative correlation; and when $r = 0$, it indicates no linear correlation (Schober et al., 2018). A scatterplot is generated to visually represent this relationship.

Table 3.7.2: *Hypothesis Testing Table*

Hypotheses	Statistical Test
H _{a1} : There is a significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.	Pearson Correlation
H _{a2} : There is a significant relationship between media multitasking habits and verbal working memory performance based on total time taken.	Pearson Correlation
H _{a3} : There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.	Spearman Correlation

H _{a4} : There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.	Pearson Correlation
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3.8 Summary

This chapter offers a comprehensive explanation of the methodology, research design, and instruments that were used in this research study. Overall, the study adopts a quantitative correlational study to investigate the relationship between media multitasking and working memory performance. The utilization of convenience sampling is implemented to recruit UNIMAS students as the targeted population for this research owing to the convenient accessibility of participants on campus, facilitating a prompt and simple means of data collection. The study employs the Short Media Multitasking Measure (MMM-S), Digit Span Task (DST), and Corsi Block-Tapping Test to quantify media multitasking habits and evaluate the verbal and visuospatial working memory performance of each participant, respectively.

CHAPTER 4

FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents the findings obtained from the correlational research, which entailed the collection of data through Google Forms. The collected data is subsequently comprehensively discussed, encompassing the presentation of participants' demographic information. Pearson correlation and Spearman correlation analysis were utilized to derive inferential statistics, facilitating the examination of the proposed hypotheses and the fulfilment of the research objectives. The collected data and data analysis are presented in the form of tables and figures.

4.1 Demographic Data

A Google Forms questionnaire was distributed among undergraduate students at Universiti Malaysia Sarawak (UNIMAS), during which the demographics of the participants were gathered from SECTION B: DEMOGRAPHIC INFORMATION. Overall, the study accumulated a total of 40 participants. The following table presents an overview of the participants' demographics:

Table 4.1: *Summary Table for Demographic Information*

Characteristics		<i>n</i>	%
Gender	Female	20	50.0
	Male	20	50.0
Race	Bumiputera Sabah	1	2.5
	Bumiputera Sarawak	10	25.0
	Chinese	20	50.0

Age	Indian	2	5.0
	Malay	7	17.5
	19 – 22 years old	23	57.5
	23 – 26 years old	16	40.0
	27 – 30 years old	1	2.5
Faculty	Faculty of Applied and Creative Arts (FACA)	2	5.0
	Faculty of Cognitive Sciences and Human Development (FCSHD)	19	47.5
	Faculty of Computer Science and Information Technology (FCSIT)	5	12.5
	Faculty of Economics and Business (FEB)	3	7.5
	Faculty of Engineering (FENG)	5	12.5
	Faculty of Medicine and Health Sciences (FMHS)	3	7.5
	Faculty of Resource Science and Technology (FRST)	1	3.5
	Faculty of Social Sciences and Humanities (FSSH)	2	5.0
Year of Study	Year 1	8	20.0
	Year 2	8	20.0
	Year 3	19	47.5
	Year 4	5	12.5
CGPA	2.99 – 2.50	3	7.5
	3.49 – 3.00	15	37.5
	4.00 – 3.50	22	55.0

4.1.1 Gender of the Participants

Table 4.1.1: *Frequency and Percentage of Participants' Gender*

Gender	<i>n</i>	%
Female	20	50.0
Male	20	50.0
Total	40	100.0

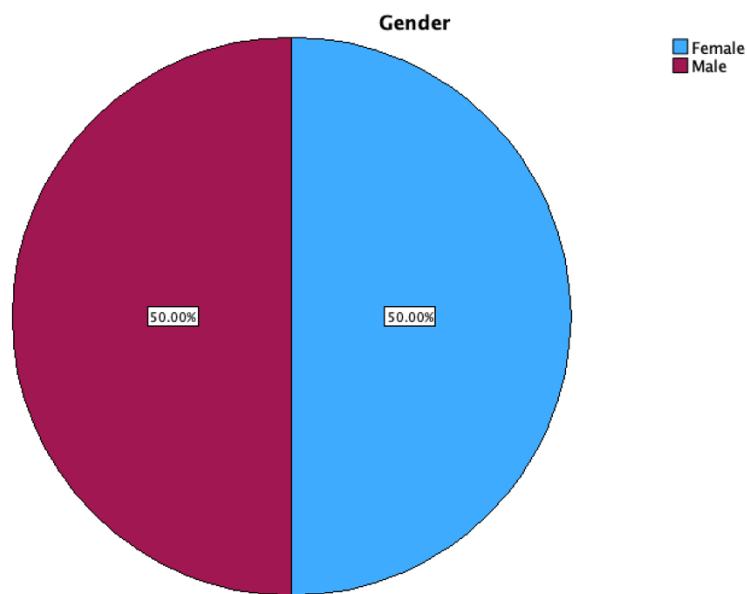


Figure 4.1.1: *Pie Chart of Participants' Gender*

Table 4.1.1 and Figure 4.1.1 depict the frequency and percentage distribution of participants' gender. The study includes a balanced representation of both genders, with each constituting an equivalent proportion of the total sample. Specifically, both female and male participants contribute to 50% of the total sample size, encompassing 20 out of 40 participants each.

4.1.2 Race of the Participants

Table 4.1.2: *Frequency and Percentage of Participants' Race*

Race	<i>n</i>	%
Bumiputera Sabah	1	2.5
Bumiputera Sarawak	10	25.0
Chinese	20	50.0
Indian	2	5.0
Malay	7	17.5
Total	40	100.0

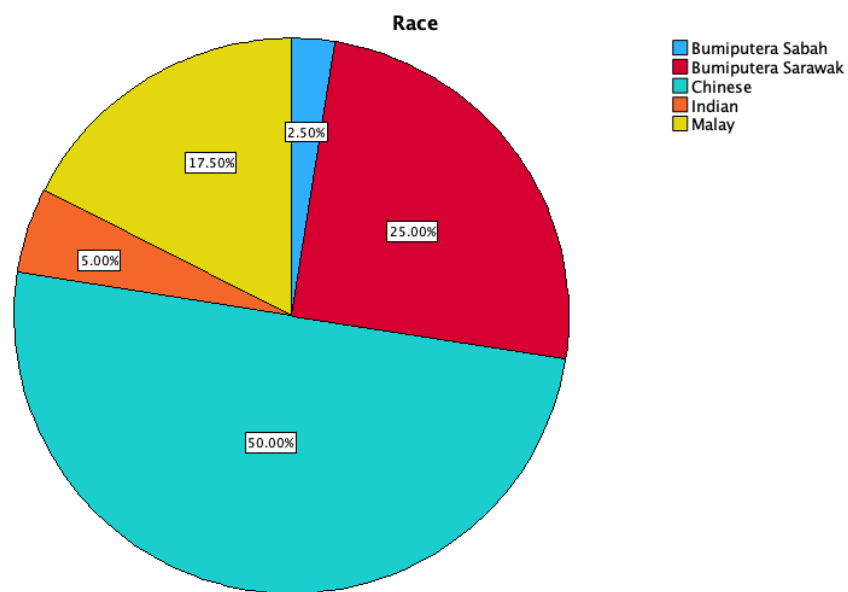


Figure 4.1.2: *Pie Chart of Participants' Race*

Referring to Table 4.1.2 and Figure 4.1.2, it is observed that the majority of the participants are Chinese, constituting 50% or 20 out of 40 participants. Bumiputera Sarawak participants comprise the second-largest group, representing 25% or 10 individuals, followed by Malay

participants at 17.5% or 7 individuals, Indian participants at 5% or 2 individuals, and finally, Bumiputera Sabah participants at 2.5% or a total of 1 participant.

4.1.3 Age of the Participants

Table 4.1.3: *Frequency and Percentage of Participants' Age*

Age	<i>n</i>	%
19 – 22 years old	23	57.5
23 – 26 years old	16	40.0
27 – 30 years old	1	2.5
Total	40	100.0

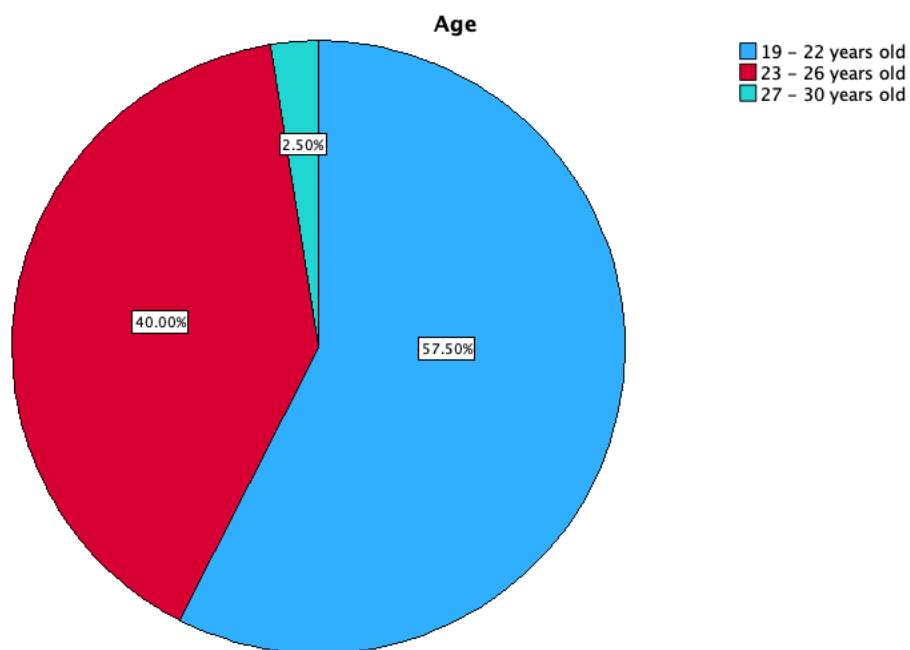


Figure 4.1.3: *Pie Chart of Participants' Age*

Table 4.1.3 and Figure 4.1.3 show that the majority of participants fall within the age group of 19-22 years old, comprising 57.5% of the total sample size, with a count of 23 participants. Participants aged between 23-26 years old constitute 40% of the sample, with a total of 16 individuals, while only one participant, representing 2.5% of the total sample size, falls within the age range of 27-30 years old.

4.1.4 Faculty of the Participants

Table 4.1.4: *Frequency and Percentage of Participants' Faculty*

Faculty	<i>n</i>	%
Faculty of Applied and Creative Arts (FACA)	2	5.0
Faculty of Cognitive Sciences and Human Development (FCSHD)	19	47.5
Faculty of Computer Science and Information Technology (FCSIT)	5	12.5
Faculty of Economics and Business (FEB)	3	7.5
Faculty of Engineering (FENG)	5	12.5
Faculty of Medicine and Health Sciences (FMHS)	3	7.5
Faculty of Resource Science and Technology (FRST)	1	2.5
Faculty of Social Sciences and Humanities (FSSH)	2	5.0
Total	40	100.0

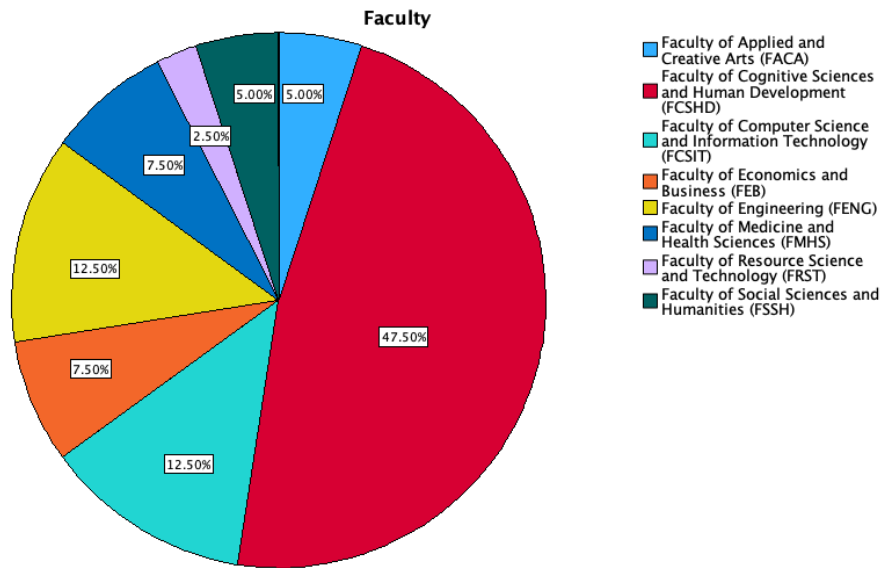


Figure 4.1.4: *Pie Chart of Participants' Faculty*

The majority of participants, totalling 47.5% or 19 participants, are from the Faculty of Cognitive Sciences and Human Development (FCSHD). Following this, both the Faculty of Computer Science and Information Technology (FCSIT) and the Faculty of Engineering (FENG) each have 12.5%, equating to 5 participants. The Faculty of Economics and Business (FEB) and the Faculty of Medicine and Health Sciences (FMHS) each consist of 7.5%, comprising 3 participants. Additionally, both the Faculty of Applied and Creative Arts (FACA) and the Faculty of Social Sciences and Humanities (FSSH) have a representation of 5%, with 2 participants each. Lastly, the Faculty of Resource Science and Technology (FRST) is represented by 2.5%, comprising 1 participant in the total sample size.

4.1.5 Year of Study of the Participants

Table 4.1.5: *Frequency and Percentage of Participants' Year of Study*

Year of Study	<i>n</i>	%
Year 1	8	20.0
Year 2	8	20.0
Year 3	19	47.5
Year 4	5	12.5
Total	40	100.0

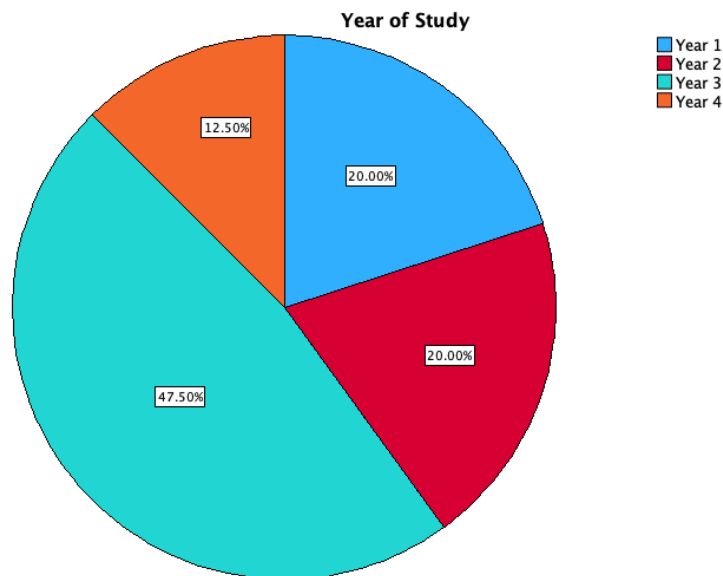


Figure 4.1.5: *Pie Chart of Participants' Year of Study*

Based on Table 4.1.5 and Figure 4.1.5, it is observed that the predominant cohort among participants is from Year 3, totalling 19 participants or 47.5% of the sample. Both Year 1 and Year 2 are each represented by 8 participants, accounting for 20% of the sample. Year 4 exhibits the smallest representation, with only 5 participants comprising 12.5% of the total sample collected.

4.1.6 CGPA of the Participants

Table 4.1.6: *Frequency and Percentage of Participants' CGPA*

CGPA	<i>n</i>	%
2.99 – 2.50	3	7.5
3.49 – 3.00	15	37.5
4.00 – 3.50	22	55.0
Total	40	100.0

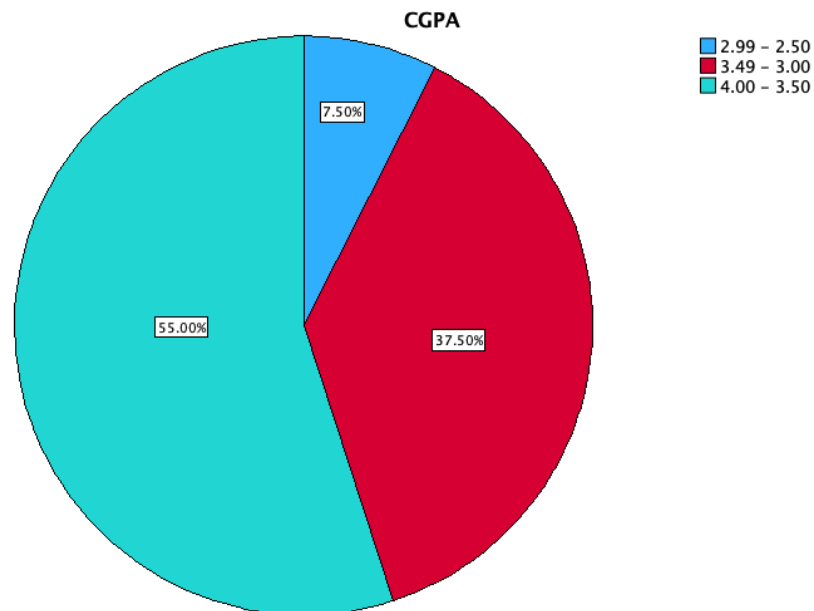


Figure 4.1.6: *Pie Chart of Participants' CGPA*

The majority of participants, comprising 55% of the total, have a CGPA falling within the range of 3.50-4.00, with a total of 22 individuals. Subsequently, 15 participants, constituting 37.5% of the sample, possess a CGPA within the range of 3.00-3.49. Finally, a total of 3 participants, representing 7.5% of the sample, have a CGPA ranging between 2.50-2.99.

4.2 Main Findings

4.2.1 Tests of Normality

Table 4.2.1: *Tests of Normality*

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Digit span (Total correct recall)	.147	40	.030	.950	40	.079
Total time taken to complete	.140	40	.046	.949	40	.069
Digit Span Task						
Corsi span (Total correct recall)	.219	40	<.001	.874	40	<.001
Total time taken to complete	.116	40	.194	.953	40	.094
Corsi Block-Tapping Test						

a. Lilliefors Significance Correction

Given the sample size of $N = 40 < 50$, the Shapiro-Wilk test results will be interpreted.

H_0 : The data is normally distributed.

H_1 : The data is not normally distributed.

If the p -value > 0.05 , we fail to reject the null hypothesis, H_0 , and the data assumes normality.

Given the small sample size, a test of normality was conducted to determine the appropriate statistical analysis. Interpreting the Shapiro-Wilk test results, the obtained p -values for Digit span ($p = 0.079$), total time taken to complete Digit Span Task ($p = 0.069$), and total time taken to complete Corsi Block-Tapping Test ($p = 0.094$) indicated no significant evidence of non-normality. Thus, Pearson correlation analysis was selected to examine these hypotheses. Conversely, the Shapiro-Wilk test indicated non-normality for the Corsi span ($p < 0.001$). Hence, to accommodate

the non-normal distribution, Spearman correlation was employed to test the relationship between media multitasking and visuospatial working memory performance based on total correct recall.

4.2.2 Descriptive Statistics

Table 4.2.2: *Descriptive Statistics Table*

	N	Minimum	Maximum	Mean	Std. Deviation
Total Media Multitasking Score	40	14	33	23.65	4.938
Mean Media Multitasking Score	40	1.56	3.67	2.6278	.54870
Digit span (Total correct recall)	40	3	9	6.45	1.449
Total time taken to complete Digit Span Task (minutes)	40	02:04	05:05	03:32	00:54
Corsi span (Total correct recall)	40	3	8	6.20	1.418
Total time taken to complete Corsi Block-Tapping Test (minutes)	40	00:46	03:43	01:50	00:42
Valid N (listwise)	40				

Table 4.2.2 presents the descriptive data analysis of the variables based on responses from 40 participants, focusing on their media multitasking scores and working memory performance, specifically in verbal and visuospatial domains, based on total correct recall and total time taken. Media multitasking scores ranged from 14 to 33 ($M=23.65$, $SD=4.94$) with mean scores from 1.56 to 3.67 ($M=2.63$, $SD=0.55$), showing moderate variability. For verbal working memory performance, measured using the Digit Span Task (DST), total correct recall ranged from 3 to 9 ($M=6.45$, $SD=1.45$), and total time taken ranged from 02:04 to 05:05 minutes ($M=3.32$, $SD=0.54$). For visuospatial working memory performance, assessed by the Corsi Block-Tapping Test, total

correct recall ranged from 3 to 8 ($M=6.20$, $SD=1.42$), and total time taken ranged from 00:46 to 03:43 minutes ($M=1.50$, $SD=0.42$). These results indicate consistent performance in total correct recall for both tasks, but notable variability in the total time taken, suggesting stable recall abilities but varied processing speeds among participants.

4.2.3 Inferential Statistics

4.2.3.1 The Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Correct Recall

H_0 : There is no significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.

H_1 : There is a significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.

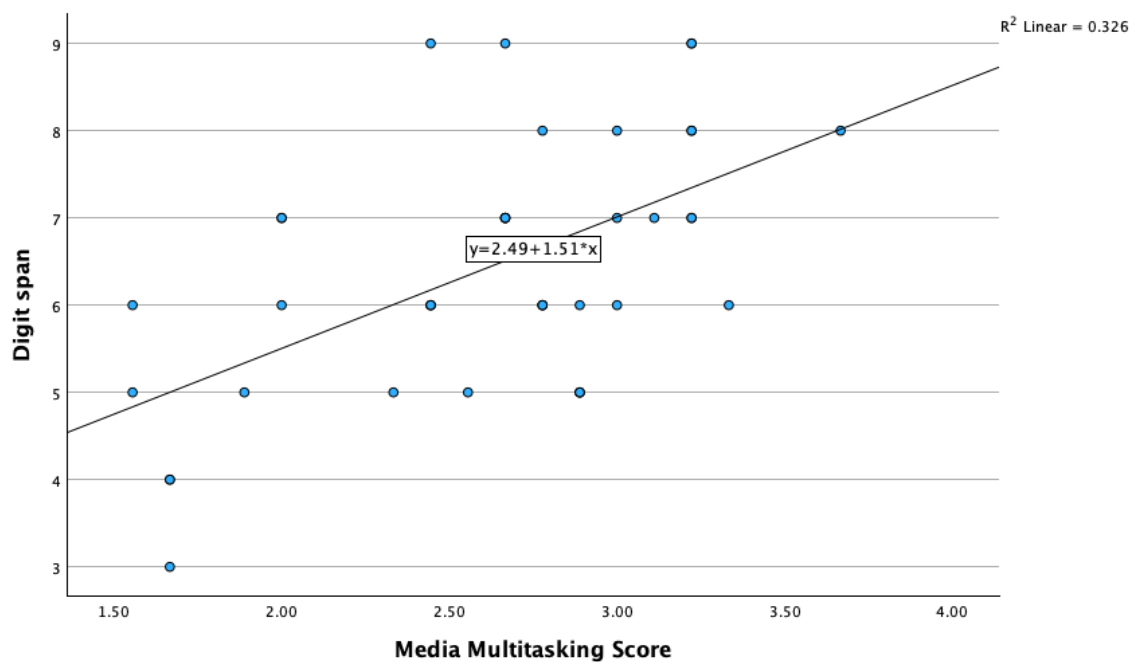


Figure 4.2.3.1: *Scatterplot on the Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Correct Recall*

Table 4.2.3.1: *Pearson Correlation Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Correct Recall*

		Media Multitasking Score	Digit span (Total correct recall)
Media	Pearson Correlation	1	.571**
Multitasking	Sig. (2-tailed)		<.001
Score	N	40	40
Digit span	Pearson Correlation	.571**	1
(Total correct	Sig. (2-tailed)	<.001	
recall)	N	40	40

** . Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation was carried out to investigate the relationship between media multitasking habits and verbal working memory performance based on total correct recall. The data revealed a strong positive relationship between media multitasking score and Digit span, with a Pearson correlation coefficient of $r = 0.571$, $p < 0.001$. Since $p < 0.05$, the null hypothesis, H_0 , is rejected, suggesting a statistically significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.

4.2.3.2 The Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Time Taken

H_0 : There is no significant relationship between media multitasking habits and verbal working memory performance based on total time taken.

H_1 : There is a significant relationship between media multitasking habits and verbal working memory performance based on total time taken.

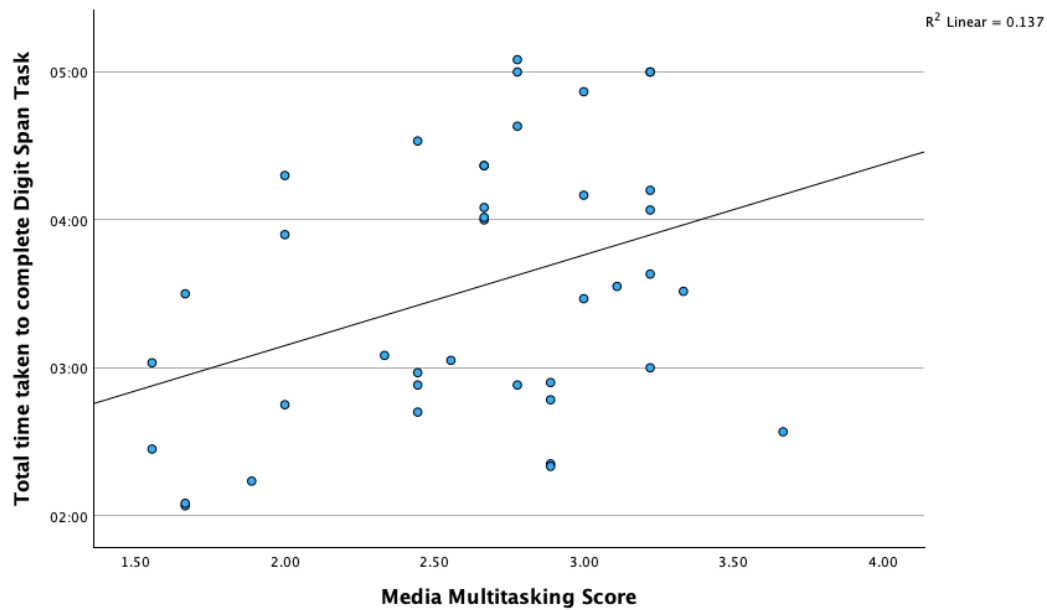


Figure 4.2.3.2: Scatterplot on the Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Time Taken

Table 4.2.3.2: Pearson Correlation Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Time Taken

		Media Multitasking Score	Total time taken to complete Digit Span Task
Media Multitasking	Pearson Correlation	1	.370*
Score	Sig. (2-tailed)		.019
	N	40	40
Total time taken to	Pearson Correlation	.370*	1
complete Digit Span	Sig. (2-tailed)	.019	
Task	N	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

Pearson correlation revealed a weak positive relationship between the media multitasking score and the total time taken to complete the Digit Span Task, with a Pearson correlation coefficient of $r = 0.370$, $p = 0.019$. Since $p < 0.05$, the null hypothesis, H_0 , is rejected, suggesting a statistically significant relationship between media multitasking habits and verbal working memory performance based on total time taken.

4.2.3.3 The Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Correct Recall

H_0 : There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.

H_1 : There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.

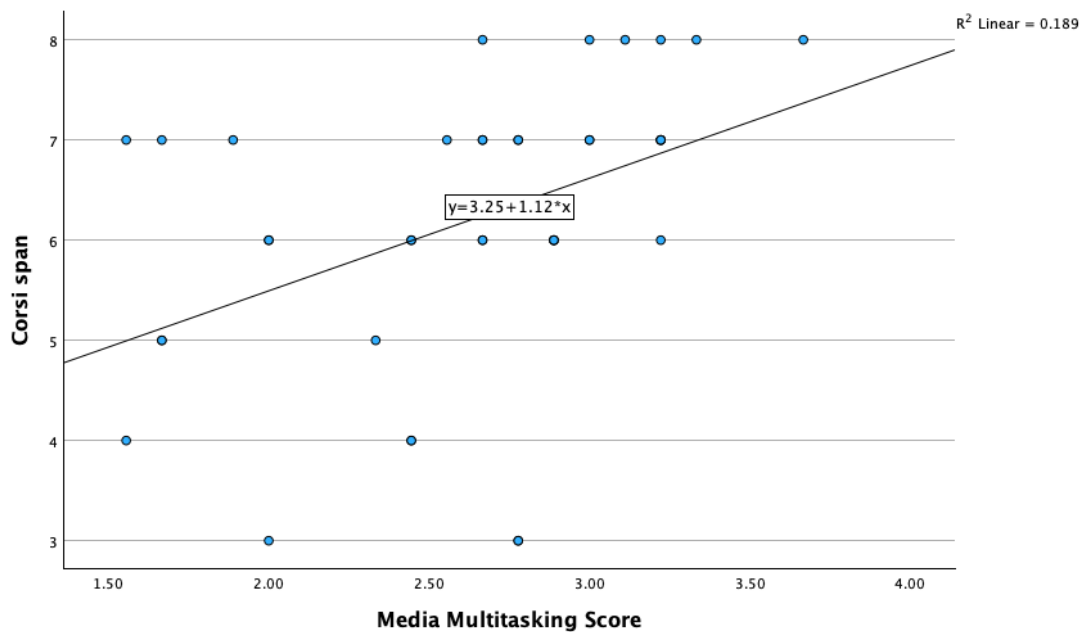


Figure 4.2.3.3: Scatterplot on the Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Correct Recall

Table 4.2.3.3: *Spearman Correlation Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Correct Recall*

			Media Multitasking Score	Corsi span (Total correct recall)
Spearman's rho	Media	Correlation Coefficient	1.000	.518**
	Multitasking	Sig. (2-tailed)	.	<.001
	Score	N	40	40
	Corsi span	Correlation Coefficient	.518**	1.000
	(Total correct	Sig. (2-tailed)	<.001	.
	recall)	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Spearman's rank-order correlation was conducted to examine the relationship between media multitasking habits and visuospatial working memory performance based on total correct recall. The results showed a moderate positive relationship between media multitasking score and Corsi span, with a correlation coefficient of $r = 0.518$, $p < 0.001$. Since $p < 0.05$, the null hypothesis, H_0 , is rejected, suggesting a statistically significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.

4.2.3.4 The Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Time Taken

H_0 : There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.

H₁: There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.

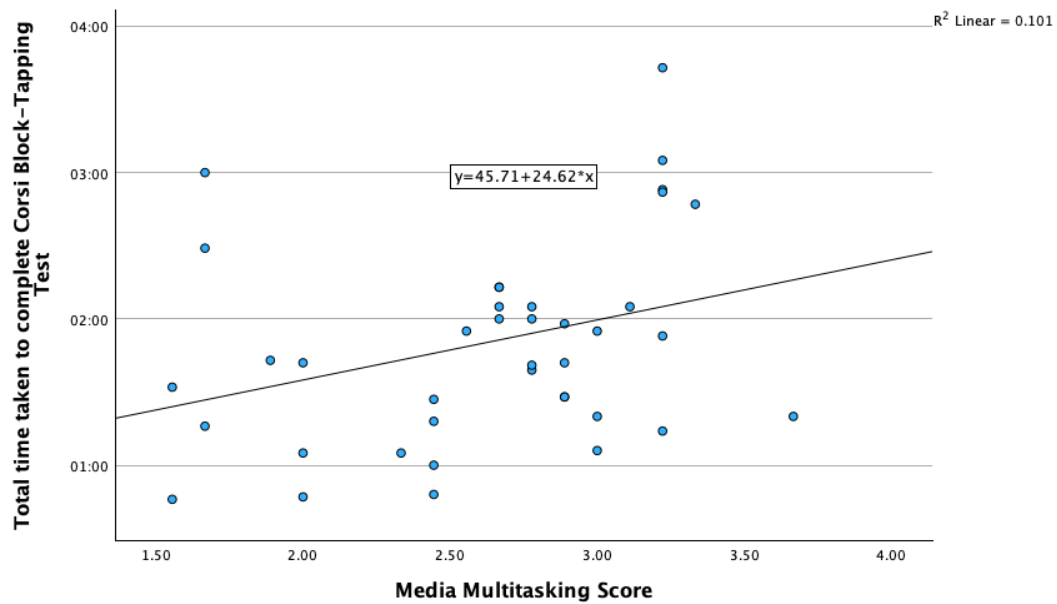


Figure 4.2.3.4: Scatterplot on the Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Time Taken

Table 4.2.3.4: Pearson Correlation Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Time Taken

		Media Multitasking Score	Total time taken to complete Corsi Block-Tapping Test
Media Multitasking Score	Pearson Correlation	1	.318*
	Sig. (2-tailed)		.046
	N	40	40
Pearson Correlation		.318*	1

Total time taken to	Sig. (2-tailed)	.046	
complete Corsi	N	40	40
Block-Tapping Test			

*. Correlation is significant at the 0.05 level (2-tailed).

Pearson correlation was employed to investigate the relationship between media multitasking habits and visuospatial working memory performance based on total time taken. The results indicated a weak positive relationship between media multitasking score and total time taken to complete the Corsi Block-Tapping Test, with a Pearson correlation coefficient of $r = 0.318$, $p = 0.046$. Since $p < 0.05$, the null hypothesis, H_0 , is rejected. Hence, there is a statistically significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.

4.2.4 Summary of Main Findings

Table 4.2.4: *Summary Table of Main Findings*

Test Performed	No.	Hypothesis	Results
Pearson Correlation	1	H_0: There is no significant relationship between media multitasking habits and verbal working memory performance based on total correct recall. H_1: There is a significant relationship between media multitasking habits and verbal working memory performance based on total correct recall.	Reject Null hypothesis, H_0 .

Pearson Correlation	2	H ₀ : There is no significant relationship between media multitasking habits and verbal working memory performance based on total time taken. H ₁ : There is a significant relationship between media multitasking habits and verbal working memory performance based on total time taken.	Reject H ₀ .	Null hypothesis,
Spearman Correlation	3	H ₀ : There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall. H ₁ : There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total correct recall.	Reject H ₀ .	Null hypothesis,
Pearson Correlation	4	H ₀ : There is no significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken. H ₁ : There is a significant relationship between media multitasking habits and visuospatial working memory performance based on total time taken.	Reject H ₀ .	Null hypothesis,

4.3 Discussion

The study is grounded in the notion that the participants' media multitasking habits could affect their working memory performance, specifically in verbal and visuospatial aspects. The main question revolves around whether frequent engagement in media multitasking serves to

enhance or impair working memory performance. The empirical results unveiled a statistically significant relationship between media multitasking habits and both verbal and visuospatial working memory performance, assessed by total correct recall and total time taken, among undergraduate students at Universiti Malaysia Sarawak (UNIMAS), with the null hypotheses (H_0) being rejected.

The study results revealed a statistically significant and strong positive relationship between media multitasking habits and verbal working memory performance, as measured by total correct recall in the Digit Span Task (DST). Firstly, this correlation suggests that participants with higher media multitasking scores, reflecting frequent engagement in media multitasking, demonstrate heightened proficiency in verbal working memory tasks, such as the DST. This finding is consistent with existing literature, as exemplified by Seddon et al. (2021), which posits that an individual's ability to manage multiple media streams concurrently may possess cognitive advantages due to the cognitive demands inherent in such multitasking activities. Moreover, the enhanced performance observed in the DST among participants with high media multitasking scores may signify a heightened adaptability or cognitive flexibility in processing verbal information amidst simultaneous exposure to media-related stimuli (Matthews et al., 2022; Seddon et al., 2021). Thus, it is plausible that individuals engaged in frequent media multitasking may develop cognitive strategies that augment their verbal working memory performance.

In addition, a statistically significant weak positive relationship has been identified between media multitasking habits and verbal working memory performance based on total time taken, indicating that participants who frequently engage in media multitasking may take longer to complete the DST. This implies a potential association between enhanced media multitasking habits and reduced processing speed or slower task execution in this domain. Notably, these

findings diverge from prior research by Murphy and Creux (2021) and Murphy et al. (2024), which reported superior processing speed in verbal working memory tasks among high media multitaskers. This discrepancy suggests that the impact of media multitasking on verbal working memory performance, as assessed by task completion time, may vary across different cognitive tasks and individual characteristics. Furthermore, while the observed correlation is statistically significant, its weak strength indicates that media multitasking habits explain only a minor proportion of the variability in verbal working memory performance based on task completion time. Consequently, the influence of media multitasking scores on this aspect of working memory is regarded as relatively modest.

Spearman's rank-order correlation analysis conducted in this study revealed a significant moderate positive relationship between media multitasking habits and visuospatial working memory performance based on total correct recall in the Corsi Block-Tapping Test. This result indicates that participants with higher media multitasking scores tend to exhibit higher Corsi span, specifically in accurately recalling the sequence of spatial locations presented in the task. A possible interpretation of this outcome is that similar to verbal working memory performance, individuals who frequently engage in media multitasking may develop cognitive skills that enhance their ability to process and retain spatial information effectively, as demanded by the administered task. This interpretation is supported by Wannagat et al. (2024), who demonstrated that superior cognitive skills corresponded with better task performance during media multitasking among both younger and older adults. Nevertheless, contrasting findings in the literature, such as those presented by Uncapher et al. (2016) and Uncapher and Wagner (2018), which reported diminished visuospatial working memory performance among heavy media multitaskers, underscores the complexity of this correlation.

Lastly, a statistically significant weak positive relationship is observed between media multitasking score and the total time taken to complete the Corsi Block-Tapping Test among UNIMAS students, indicating that as media multitasking scores increase, so does the total time taken to complete the visuospatial working memory task administered. However, given the weak strength of the correlation, it can be noted that while the findings suggest an association, causality may not be inferred. In other words, it is possible that other factors, which were not accounted for in this study, may have influenced the task completion times apart from the media multitasking habits of the participants recruited in this study.

The findings of this study underscore the potential cognitive costs associated with media multitasking habits among participants, specifically highlighting its adverse effects on working memory performance. The results reveal that participants with higher media multitasking scores exhibited elevated Digit span and Corsi span scores. However, this pattern was accompanied by increased completion times for both the Digit Span Task (DST) and the Corsi Block-Tapping Test. This suggests a possible trade-off mechanism, wherein participants with higher media multitasking tendencies achieve improved accuracy in working memory tasks at the expense of longer completion time, indicating that these individuals may be allocating more cognitive resources and time to ensure precise information processing during these tasks. In other words, while media multitaskers may maintain or even enhance their accuracy in the working memory tasks, they do so by extending the time spent on completing these tasks, possibly as a compensatory strategy to counterbalance their cognitive load imposed by their media multitasking habits.

4.4 Summary

This chapter presents the results of the study examining the relationship between media multitasking habits and working memory performance. The study recruited a sample of 40

participants, ensuring equal representation from both genders. The majority of participants were of Chinese ethnicity, aged between 19 and 22 years old, enrolled in the Faculty of Cognitive Sciences and Human Development (FCSHD), primarily in Year 3, with CGPA ranging from 3.50 to 4.00. The findings revealed consistent recall abilities across verbal and visuospatial working memory tasks, but significant variability in the task completion times, suggesting stable working memory performance for recall with differing processing speeds among the participants. Additionally, significant relationships were found between media multitasking habits and both verbal and visuospatial working memory performance based on total correct recall and total time taken. Specifically, participants with higher media multitasking scores demonstrated higher Digit span and Corsi span, alongside longer time taken to complete Digit Span Task (DST) and Corsi Block-Tapping Test, evaluating verbal and visuospatial working memory performance, respectively.

CHAPTER 5

LIMITATION, IMPLICATION, RECOMMENDATION AND CONCLUSION

5.0 Introduction

This chapter delves into the limitations and implications of the research exploring the relationship between media multitasking and working memory performance, particularly in the verbal and visuospatial domains, as measured by total correct recall and total time taken among UNIMAS students. Additionally, it offers recommendations for future research and concludes with a concise summary of the entire study.

5.1 Research Summary

The study aims to explore the relationship between media multitasking habits and working memory performance, focusing on both verbal and visuospatial aspects, measured by total correct recall and total time taken among students at Universiti Malaysia Sarawak (UNIMAS). This research seeks to determine whether media multitasking habits enhance or impair working memory performance, thereby establishing the nature of the relationship between these variables.

A quantitative correlational study design was employed, utilizing convenience sampling to recruit a total of 40 participants. Participants were required to complete the Short Media Multitasking Measure (MMM-S) to assess their media multitasking habits. Additionally, the Digit Span Task (DST) was used to evaluate verbal working memory performance, while the Corsi Block-Tapping Test assessed visuospatial working memory performance. Data analysis involved the application of Pearson and Spearman Rank-Order Correlations to identify any significant relationships between media multitasking and working memory performance.

Overall, the results of the study revealed the potential cognitive costs associated with media multitasking habits among the participants, particularly its detrimental effects on working memory performance. Participants with higher media multitasking scores exhibited higher Digit span and Corsi span scores, alongside an increased time taken to complete both the Digit Span Task (DST) and Corsi Block-Tapping Test. This suggests a possible trade-off, where improved accuracy is achieved at the expense of longer task completion times. In essence, this indicates that participants may be allocating more cognitive resources and time to ensure accurate information processing during these working memory tasks.

5.2 Limitations of Study

The current study has certain limitations that warrant acknowledgement and consideration in future research. One of the primary limitations is the potential influence of uncontrolled confounding variables, such as individual differences in cognitive abilities, which could bias the results (Sponheim, 2023). For instance, the participants with inherently higher cognitive abilities may perform better on working memory tasks regardless of their media multitasking habits, complicating the isolation of the relationship between media multitasking and verbal and visuospatial working memory performance. Furthermore, the use of convenience sampling in this study may further introduce confounding variables (Andrade, 2021; Farrokhi & Mahmoudi-Hamidabad, 2012). Nevertheless, the study attempts to mitigate these by recruiting participants with the same educational level (bachelor's degree) from the same university (UNIMAS), and ensuring equal gender representation, thus controlling for educational level and gender-related differences. Additionally, the use of different and randomized questions in the Digit Span Task (DST) and Corsi Block-Tapping Test helps to minimize this limitation.

Another limitation of this study is the relatively small and homogenous sample size of 40 participants, drawn from Universiti Malaysia Sarawak (UNIMAS). This limitation may restrict the generalizability of the findings to a broader population (Marszalek et al., 2011; Nayak, 2010), with potentially different media multitasking habits or cognitive profiles. With the small sample size, the results may not accurately reflect the entire student population at UNIMAS, thereby reducing the statistical power of the study. However, it is notable that the recruitment process for this study included participants from 8 out of the 10 faculties within UNIMAS. This approach helps to ensure a more diverse sample, increasing the representativeness of the study's findings across different academic disciplines with varying media multitasking habits. This strategy partially addresses the limitation of sample homogeneity and enhances the generalizability of the results within the university context.

Additionally, the use of self-reported data to access the media multitasking habits of the participants introduces potential biases that could affect the validity of the results (Brenner & DeLamater, 2016). For example, participants might overestimate or underestimate their media multitasking behaviours due to social desirability bias, recall inaccuracies, or subjective interpretations of what constitutes media multitasking. These biases can lead to inaccurate measurements of the media multitasking habits. Nonetheless, the use of a validated instrument, the Short Media Multitasking Measure (MMM-S), which has a high Cronbach alpha of 0.90, to measure the participants' media multitasking habits indicates strong internal consistency and reliability of the tool in measuring media multitasking (Baumgartner et al., 2017). This enhances the credibility of the research findings, despite the self-reported nature of the data, thereby reducing the influence of this limitation.

The study's reliance on specific tasks, such as the Digit Span Task (DST) and Corsi Block-Tapping Test, to gauge working memory performance presents a minor but relevant limitation. While widely utilized, these tasks may not fully capture the dynamic and multifaceted nature of working memory performance, where verbal, visuospatial, and executive functions interact in complex ways (Baddeley & Hitch, 1974). Consequently, they may primarily evaluate static aspects of working memory, overlooking its broader functional capacities in real-world media multitasking scenarios, potentially leading to findings that do not fully reflect the impact of media multitasking habits on working memory performance. However, the use of the Digit Span Task (DST) and Corsi Block-Tapping Test, with Cronbach alpha values of 0.68 to 0.89 (Gignac et al., 2017; Paula et al., 2016) and 0.75 (Paula et al., 2016) respectively, suggests that they consistently measure the verbal and visuospatial aspects of working memory they are designed to assess. Moreover, these tasks provide objective assessments of working memory performance, reducing the influence of participants' biases and thus enhancing the validity of the results.

5.3 Implications of Study

The current study aims to explore the relationship between media multitasking habits and working memory performance in the verbal and visuospatial domains among Universiti Malaysia Sarawak (UNIMAS) students, using measures of total correct recall and total time taken. While existing research has investigated various aspects of the relationship between media multitasking and working memory performance (Alzahabi et al., 2017; Lui & Wong, 2012; Minear et al., 2013; Moisala et al., 2016; Ophir et al., 2009; Ralph & Smilek, 2017; Yap & Lim, 2013), significant research gaps remain, specifically in addressing the mixed and inconclusive findings that suggest both beneficial and detrimental effects of heavy media multitasking on working memory

performance, the need for targeted research on Malaysian university students, and the call for methodological advancements beyond mere categorization of participants into heavy and light media multitaskers (HMMs and LMMs).

The study enhances the understanding of the relationship between media multitasking habits and verbal and visuospatial working memory performance. The findings, based on measures of total correct recall and total time taken, align with the Cognitive Control Theory and Baddeley's Model of Working Memory, positing that media multitasking negatively impacts both types of working memory. This suggests that various components of working memory are similarly vulnerable to these effects. An increase in total correct recall for both verbal and visuospatial working memory tasks implies that participants with higher media multitasking scores might have a greater capacity for information recall, indicating an enhanced ability to store and retrieve information. However, the increase in total time taken, although weak, indicates that higher media multitasking scores are associated with longer processing and retrieval times. This trade-off, where participants with higher media multitasking scores recall more information but require more time, signifies poorer working memory performance, as an efficient working memory system ideally balances speed and accuracy (Baddeley, 2000; Cain & Mitroff, 2011; Uncapher et al., 2016).

This research holds significant implications for educational institutions and policymakers interested in enhancing learning outcomes among university students. The present study purposes the exploration of media multitasking as a potential factor affecting working memory performance among university students. The findings revealed a dual relationship, suggesting that while some aspects of working memory performance might benefit from media multitasking, the overall cognitive load and processing speed can decrease working memory efficiency. Understanding this relationship can help develop interventions to mitigate the negative impacts of media multitasking

on students' cognitive performance. Educators can design curricula that incorporate strategies to reduce media multitasking during learning activities, creating more engaging and interactive lecture environments. Additionally, universities can implement programs to raise awareness about the cognitive costs of media multitasking, educating students on how it can impair their learning and providing strategies to manage media use more effectively.

5.4 Recommendations

Based on the research findings and limitations, several recommendations can be proposed for future research endeavours. Future studies should investigate additional variables that could impact the relationship between media multitasking and working memory performance, such as individual differences in cognitive abilities and the timing of working memory tasks administered. To address the potential influence of these uncontrolled confounding variables, stricter controls or statistical techniques should be employed in future studies, particularly to account for cognitive differences among participants. This could involve using standardized cognitive assessments, like the Wechsler Adult Intelligence Scale (WAIS-IV) (Wechsler, 2013 as cited in Cicinelli et al., 2022), to measure baseline cognitive abilities before evaluating working memory performance in media multitasking contexts. Furthermore, controlling for environmental factors, such as ensuring consistent testing conditions and times of day the tasks are administered, can help mitigate variability in performance due to external factors (Cherry, 2023).

Besides that, future research should aim to replicate this study using different populations or settings to investigate the consistency or variability of the relationship between media multitasking habits and working memory performance across diverse groups or contexts. Additionally, increasing the sample size beyond the relatively small and homogenous sample of

40 participants used in this study would enhance the statistical power and generalizability of the results (Lakens, 2022; Suresh & Chandrashekhara, 2012). Including participants from multiple universities for future research would help generalize the findings to Malaysian university students beyond a single institution, such as UNIMAS in the present study. Longitudinal designs could also be employed to track changes over time (Cherry, 2023; Simkus, 2023), providing a deeper understanding of the association between media multitasking habits and working memory performance.

Additionally, while the Short Media Multitasking Measure (MMM-S) has exhibited high Cronbach alpha and internal consistency in past research (Baumgartner et al., 2017), its reliance on self-reported data can introduce biases. Therefore, future research should aim to supplement this self-report measure with objective assessments of media multitasking habits, such as smartphone usage tracking apps or software, which can help the researcher to collect detailed data on participants' interaction with their devices, thereby reducing potential biases and providing more accurate data on media multitasking habits. Moreover, to better capture the dynamic nature of working memory performance in real-world media multitasking scenarios, future research should incorporate ecologically valid tasks that mimic everyday media multitasking activities. This approach could involve tasks that require participants to simultaneously engage in media multitasking while performing working memory tasks.

In addition to traditional working memory tasks, such as the Digit Span Task (DST) and Corsi Block-Tapping Test used in this study, future research should explore alternative measures of working memory performance, including executive functions and attentional control (Baddeley, 2000; Baddeley & Hitch, 1974; Chai et al., 2018). This broader approach would provide a more comprehensive insight into how an individual's media multitasking habits relate to his/her working

memory performance. To further elucidate this correlation, it is imperative to delve into the underlying mechanisms and processes that facilitate these effects. Hence, integrating neuroimaging techniques like functional magnetic resonance imaging (fMRI) could help assess the neural activities associated with media multitasking habits and cognitive functions, particularly on working memory performance (Moisala, 2017). By adopting these strategies, future research can expand on the current findings and contribute to a more nuanced understanding of how media multitasking affects working memory performance among university students.

5.5 Summary

This chapter addresses the limitations, implications, and recommendations derived from the research on the relationship between media multitasking habits and working memory performance among UNIMAS students. The findings of the study reveal significant positive relationships between media multitasking and both verbal and visuospatial working memory performance, based on total correct recall and total time taken. Participants with greater media multitasking scores demonstrated improved recall accuracy, albeit with increased task completion times. Overall, this research has notable implications for cognitive function and academic performance, particularly regarding the effects of media multitasking. It advances current theories and academic literature, offers practical applications, and provides guidance for university policymakers. Despite its contributions, the study acknowledges limitations that suggest directions for future research to further explore the relationship between media multitasking habits and working memory performance. Nonetheless, this correlational study offers valuable insights and establishes a foundation for subsequent research endeavours. A key takeaway is that media multitasking among university students can detrimentally affect working memory performance,

potentially impacting academic performance. Hence, understanding and managing media multitasking habits is crucial for optimizing cognitive performance and academic success among university students.

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APPENDIX A
RESEARCH QUESTIONNAIRE

**THE RELATIONSHIP BETWEEN MEDIA MULTITASKING AND WORKING
MEMORY PERFORMANCE**

Greetings to all. I am Hannah Tan Yit Yung (78017), a third-year Psychology student from the Faculty of Cognitive Sciences and Human Development (FCSHD) at Universiti Malaysia Sarawak (UNIMAS). I am currently conducting a research study for my Final Year Project (FYP) titled “The Relationship Between Media Multitasking and Working Memory Performance” and I would like to invite you to participate in this study. This research project is supervised by En. Mohamad Azhari Bin Abu Bakar.

This questionnaire consists of FIVE sections: Section A: Informed Consent, Section B: Demographic Information, Section C: Short Media Multitasking Measure (MMM-S), Section D: Digit Span Task (DST), and Section E: Corsi Block-Tapping Test.

Your cooperation and participation in responding to this questionnaire is much appreciated. Thank you very much.

Should you require clarification, please do not hesitate to contact me through the following contact details:

 Email: 78017@siswa.unimas.my

 Phone no: 01133692991

SECTION A

INFORMED CONSENT FORM

Please read through this section thoroughly before deciding to participate in this research study.

Research Title: The Relationship Between Media Multitasking and Working Memory Performance

Supervisor: En. Mohamad Azhari Bin Abu Bakar

Purpose of the Study: The purpose of this research is to identify the relationship between media multitasking and working memory performance among UNIMAS students. It aims to examine the media multitasking habits of the participants and their relationship with verbal and visuospatial working memory performance.

Potential Risks and Benefits of Participating: There are no foreseen risks associated with participating in this study. However, the tasks used to measure verbal and visuospatial working memory performance might be mildly challenging. The potential benefits include your valuable contribution to scientific knowledge in the field of cognitive psychology and related fields.

Confidentiality: All data collected will be kept strictly confidential, only be accessible to the research team, and used solely for academic purposes. Study investigators, qualified monitors and auditors, the sponsor or its affiliates, and governmental or regulatory authorities, have direct access to participants' records in order to make sure that the study is conducted correctly, and the data are

recorded correctly. Identifiable information will be kept confidential, and all data will be anonymized during analysis and reporting.

Voluntary Participation: Participation in this study is entirely voluntary. Participants have the right to withdraw at any time without penalty. If you agree to participate, you will be asked to complete a questionnaire, which will take approximately 15-20 minutes of your time.

Consent: By clicking on the “I Agree” button indicates that I have read and understood the information for the above study. I have sufficient time to consider my participation in the study and willingly give my consent to participate in this research titled “The Relationship Between Media Multitasking and Working Memory Performance”.

☐ I Agree

SECTION B

DEMOGRAPHIC INFORMATION

This section aims to identify the diverse demographic perspectives of the participants. Please take a moment to provide the following details.

Gender	☐ Male ☐ Female
Race	☐ Malay ☐ Chinese

	☐ Indian ☐ Bumiputera Sarawak ☐ Bumiputera Sabah ☐ Other...
Age	☐ 19 - 22 years old ☐ 23 - 26 years old ☐ 27 - 30 years old ☐ 31 years old and above
Faculty	☐ Faculty of Computer Science and Information Technology (FCSIT) ☐ Faculty of Cognitive Sciences and Human Development (FCSHD) ☐ Faculty of Economics and Business (FEB) ☐ Faculty of Engineering (FENG) ☐ Faculty of Applied and Creative Arts (FACA) ☐ Faculty of Medicine and Health Sciences (FMHS) ☐ Faculty of Social Sciences and Humanities (FSSH) ☐ Faculty of Resource Science and Technology (FRST) ☐ Faculty of Language and Communication (FLC) ☐ Faculty of Built Environment (FBE)
Year of Study	☐ Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4 ☐ Year 5

	☐ Other...
CGPA	☐ 4.00 - 3.50 ☐ 3.49 - 3.00 ☐ 2.99 - 2.50 ☐ 2.49 and below

SECTION C

SHORT MEDIA MULTITASKING MEASURE (MMM-S)

This section aims to examine the media multitasking habits of the participants. Please choose the scale which best describes the following question.

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Never	Sometimes	Often	Very Often

While watching TV, how often do you engage in the following activities...				
...listening to music	1	2	3	4
...sending messages via phone or computer	1	2	3	4
...using social networking sites	1	2	3	4
While using social networking sites, how often do you engage in the following activities...				
...listening to music	1	2	3	4
...sending messages via phone or computer	1	2	3	4
...watching TV	1	2	3	4
While sending messages via phone or computer, how often do you engage in the following activities...				

...listening to music	1	2	3	4
... using social networking sites	1	2	3	4
...watching TV	1	2	3	4

SECTION D

DIGIT SPAN TASK (DST)

This section aims to assess the verbal working memory performance of the participants using the Digit Span Task (DST). Please proceed to the provided link to complete the test. In the experiment, the participants will be presented with a sequence of two digits and will be instructed to recall and repeat the digits in the same sequence. The process is iterated with each trial, gradually increasing the length of the sequence, until the participants reach a point where they are unable to repeat the sequence anymore. The duration of the trial will be recorded. The participants are then required to provide the necessary details below.

Link: https://www.psytoolkit.org/experiment-library/experiment_digitspan.html

Digit span	
Total time taken to complete the test	

SECTION E

CORSI BLOCK-TAPPING TEST

This section aims to assess the visuospatial working memory performance of the participants using the Corsi Block-Tapping Test. Please proceed to the provided link to complete the test. In the experiment, the participants will be presented with a sequence of two blocks and will be required

to click on the blocks in the same order as previously shown in the sequence. If the answer is correct, the participants will advance to the next level by completing a sequence with greater number of blocks. However, if the participants provide incorrect answers twice, the test will conclude. The duration of the trial will be recorded. The participants are then required to provide the necessary details below.

Link: https://www.pytoolkit.org/experiment-library/experiment_corsi.html

Corsi span	
Total time taken to complete the test	

Thank you for your time and participation.

APPENDIX B
PILOT STUDY FEEDBACK FORM

**THE RELATIONSHIP BETWEEN MEDIA MULTITASKING AND WORKING
MEMORY PERFORMANCE – Pilot Study Feedback Form**

Greetings to all.

I am Hannah Tan Yit Yung (78017), a third-year Psychology student from the Faculty of Cognitive Sciences and Human Development (FCSHD) at Universiti Malaysia Sarawak (UNIMAS). I am currently conducting a pilot study for my Final Year Project (FYP) titled "The Relationship Between Media Multitasking and Working Memory Performance" and I would like to invite you to participate. This research project is supervised by En. Mohamad Azhari Bin Abu Bakar.

Your cooperation and participation in responding to this feedback form is much appreciated. Your feedback on this questionnaire will assist the researcher in making improvements prior to the main study.

Thank you very much.

Should you require clarification, please do not hesitate to contact me through the following contact details:

 Email: 78017@siswa.unimas.my

 Phone no: 01133692991

Full Name	
Matric No.	
Gender	☐ Male ☐ Female
Faculty	☐ Faculty of Computer Science and Information Technology (FCSIT) ☐ Faculty of Cognitive Sciences and Human Development (FCSHD) ☐ Faculty of Economics and Business (FEB) ☐ Faculty of Engineering (FENG) ☐ Faculty of Applied and Creative Arts (FACA) ☐ Faculty of Medicine and Health Sciences (FMHS) ☐ Faculty of Social Sciences and Humanities (FSSH) ☐ Faculty of Resource Science and Technology (FRST) ☐ Faculty of Language and Communication (FLC) ☐ Faculty of Built Environment (FBE)
Year of Study	☐ Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4 ☐ Year 5 ☐ Other...

SECTION C

SHORT MEDIA MULTITASKING MEASURE (MMM-S)

Were the questions able to effectively reflect your media multitasking habits?

☐ Yes

☐ No

Did you encounter any questions that were confusing or unclear?

☐ Yes

☐ No

If you answered “yes” to the previous question, please provide suggestions for improvement.

SECTION D

DIGIT SPAN TASK (DST)

Did you understand the activities while you were doing the test?

☐ Yes

☐ No

Were the instructions easy to follow?

☐ Yes

☐ No

Do you think the test effectively evaluates verbal working memory performance?

☐ Yes

☐ No

SECTION E

CORSI BLOCK-TAPPING TEST

Did you understand the activities while you were doing the test?

☐ Yes

☐ No

Were the instructions easy to follow?

☐ Yes

☐ No

Do you think the test effectively evaluates visuospatial working memory performance?

☐ Yes

☐ No

GENERAL FEEDBACK

How long did it take you to complete the questionnaire?

Did you find the length of the questionnaire appropriate?

☐ Yes

☐ No

Were there any sections that you felt could be improved or expanded upon? If yes, please provide details.

Do you have any additional comments or suggestions for improving the questionnaire or the study as a whole?

Thank you very much for your time and participation in this pilot study.

APPENDIX C

INSTRUMENTS

1.0 Short Media Multitasking Measure (MMM-S)

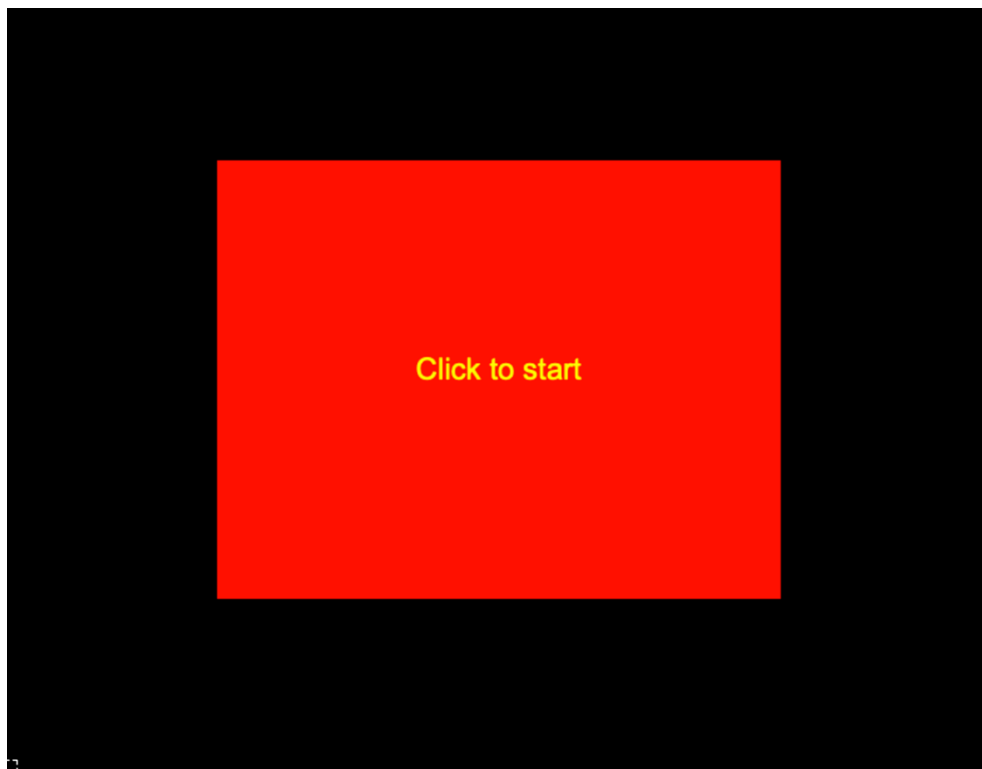
This instrument aims to examine the media multitasking habits of the participants. Please choose the scale which best describes the following question.

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Never	Sometimes	Often	Very Often

While watching TV, how often do you engage in the following activities...				
...listening to music	1	2	3	4
...sending messages via phone or computer	1	2	3	4
...using social networking sites	1	2	3	4
While using social networking sites, how often do you engage in the following activities...				
...listening to music	1	2	3	4
...sending messages via phone or computer	1	2	3	4
...watching TV	1	2	3	4
While sending messages via phone or computer, how often do you engage in the following activities...				
...listening to music	1	2	3	4
... using social networking sites	1	2	3	4
...watching TV	1	2	3	4

2.0 Working Memory Performance Task

Example of Digit Span Task (DST)



Instructions 1 out of 3

In this experiment you will try to memorize numbers you see on the screen. All numbers are between 0 and 9. We call such numbers **digits**.

You will see a sequence of **digits**, one after another.

Remember the whole sequence....

back forward

Instructions 2 out of 3

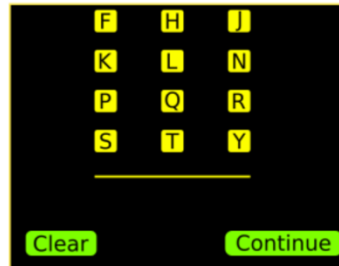
Once you have remembered the digits, you need to repeat them.

You see a key pad on the screen (see image). Use the mouse to click them **in the same order** as they were shown.

If you make a mistake, you can **Clear** the last one you entered.

After you have entered all the letters, you click **Continue**

The computer will tell you if you remembered the letters correctly or not.



back

forward

Instructions 3 of 3

You will have to remember several sequences.

The sequence of letters will get longer until you can no longer remember them

At the end of the experiment, you will get your total score.

The total score is known as the digit span.

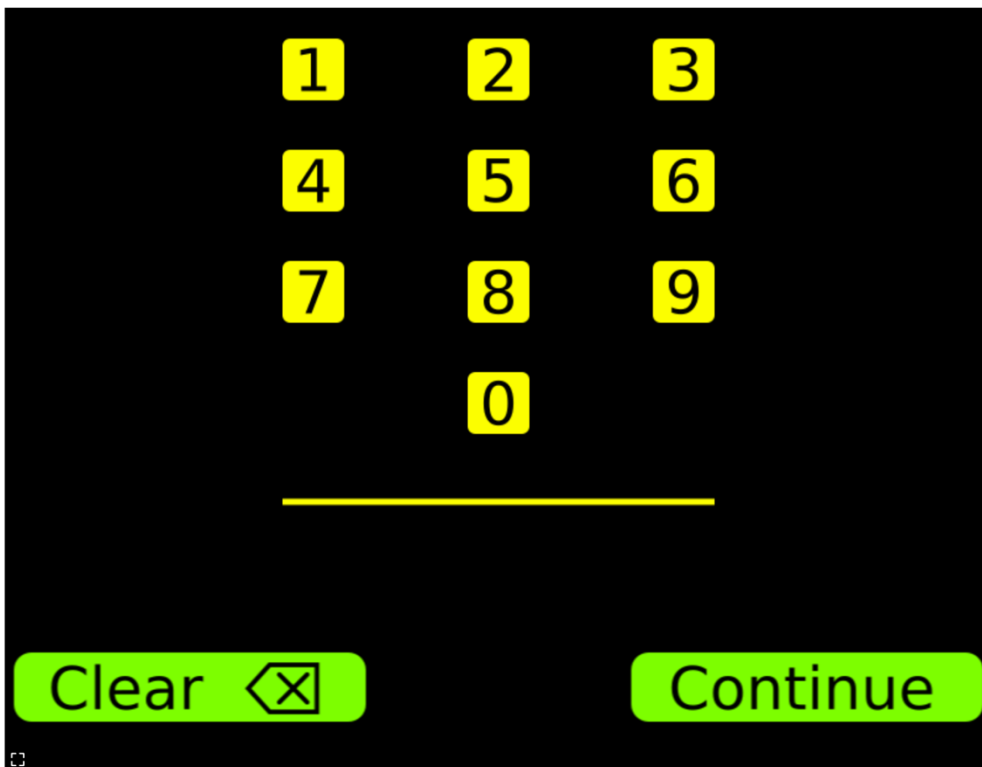
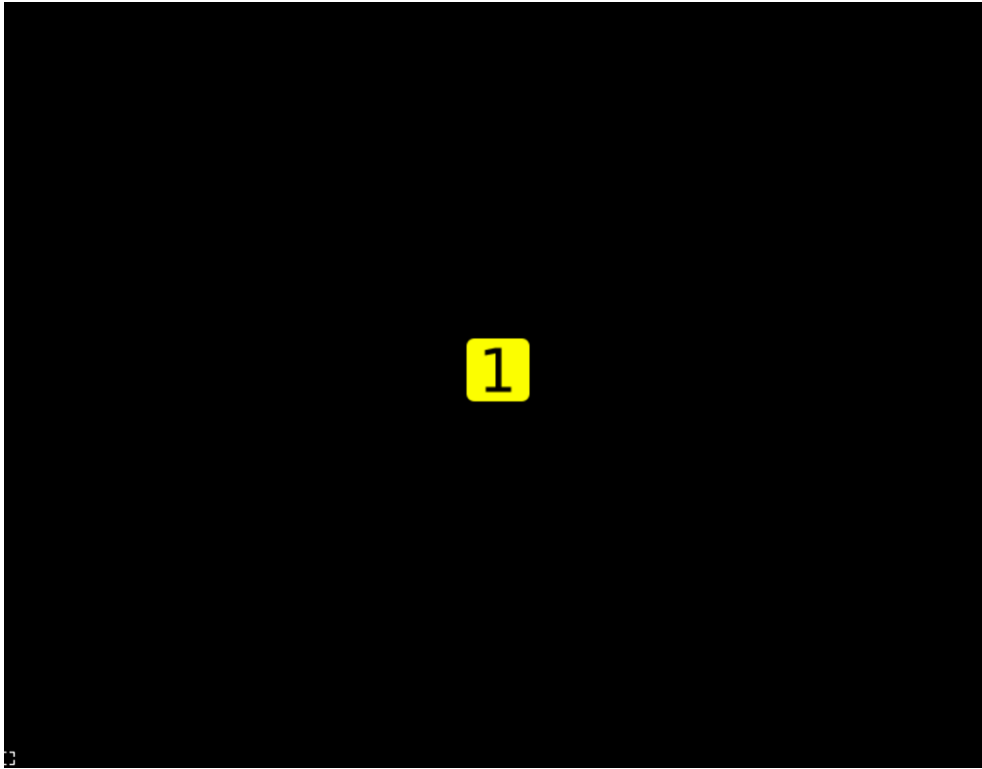
back

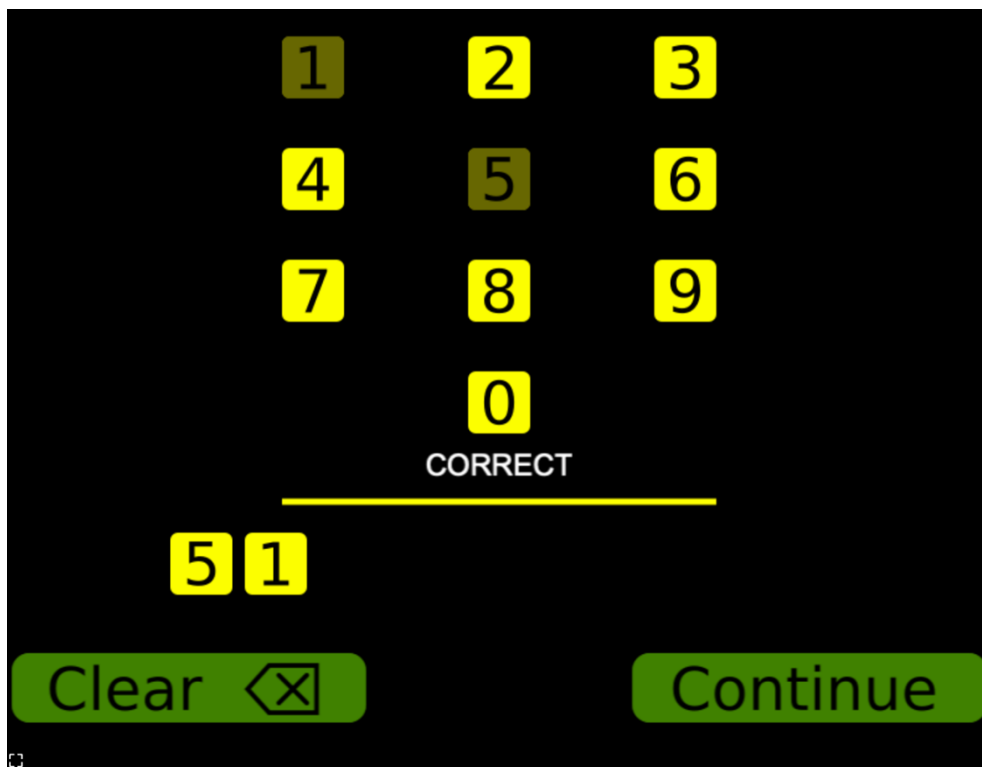
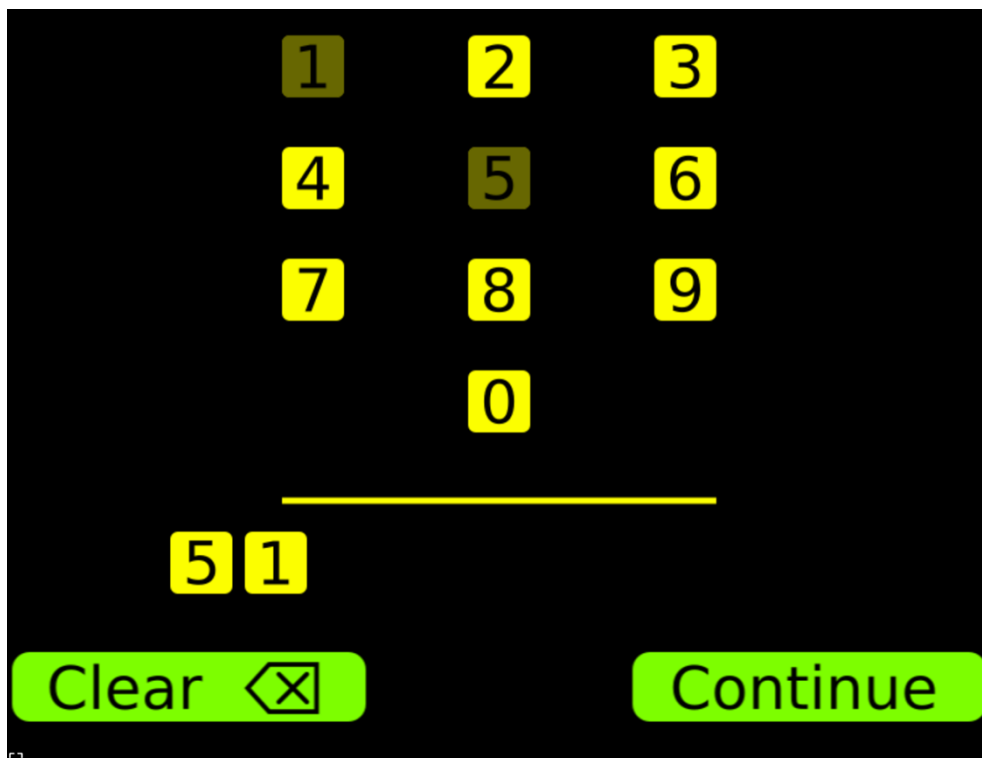
forward

Start now

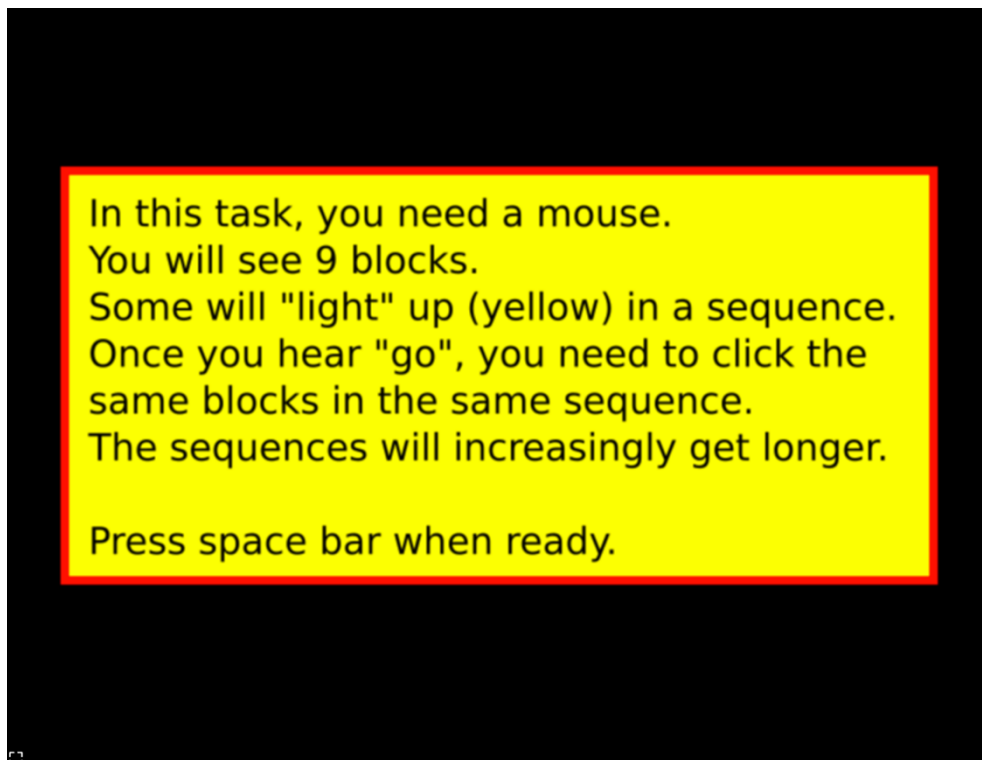
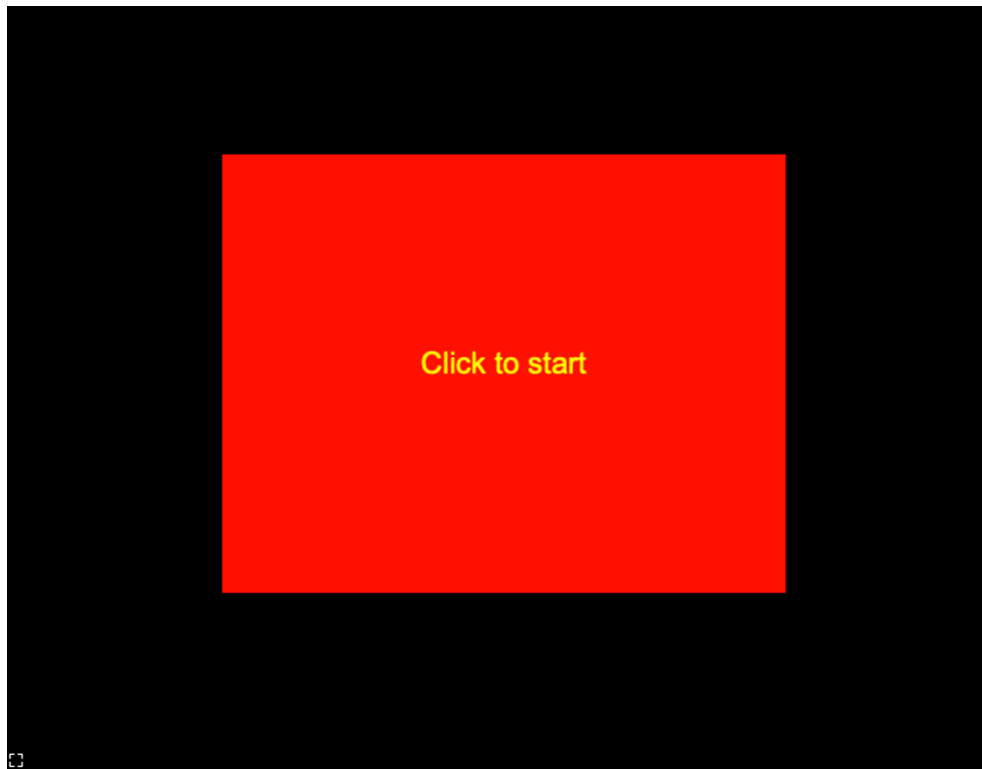
Get ready now!

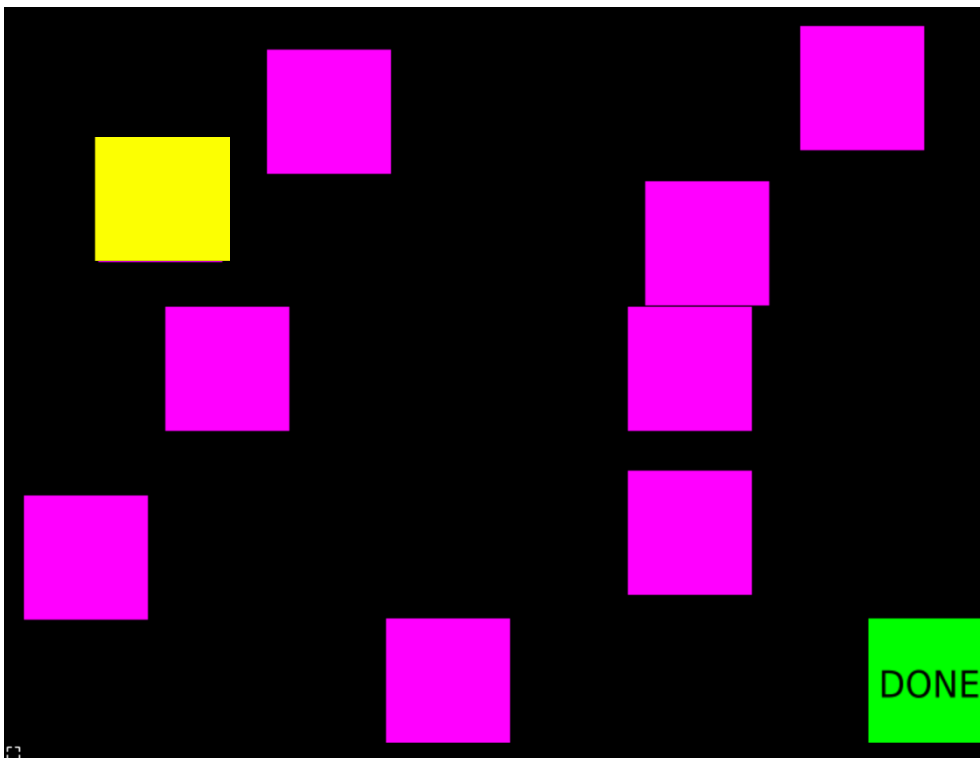
5

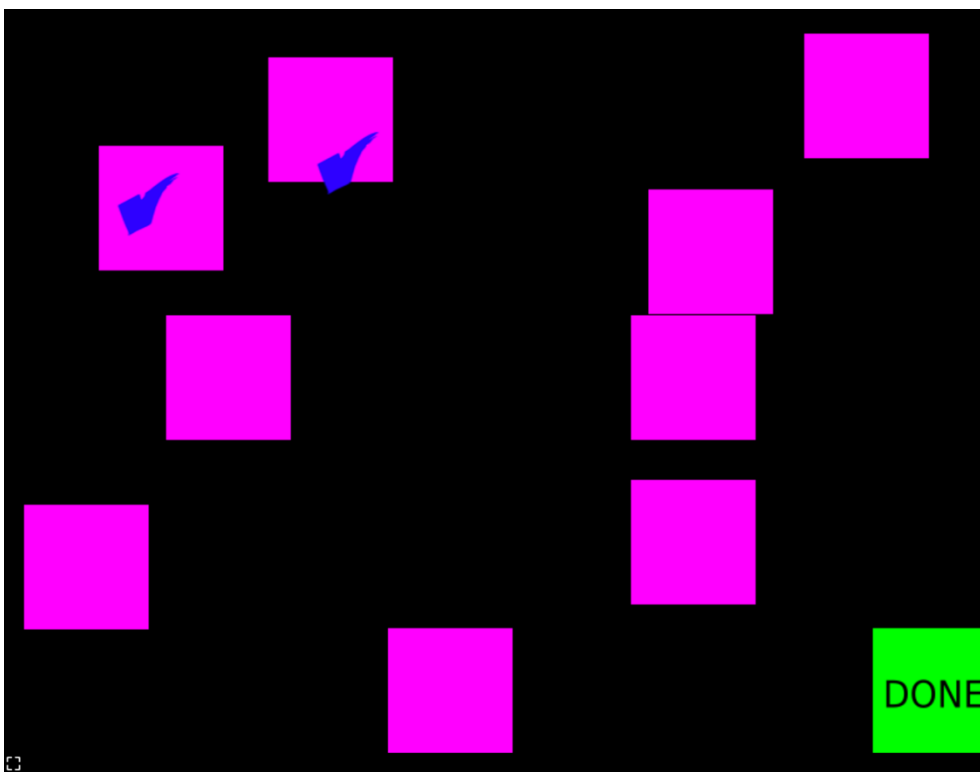
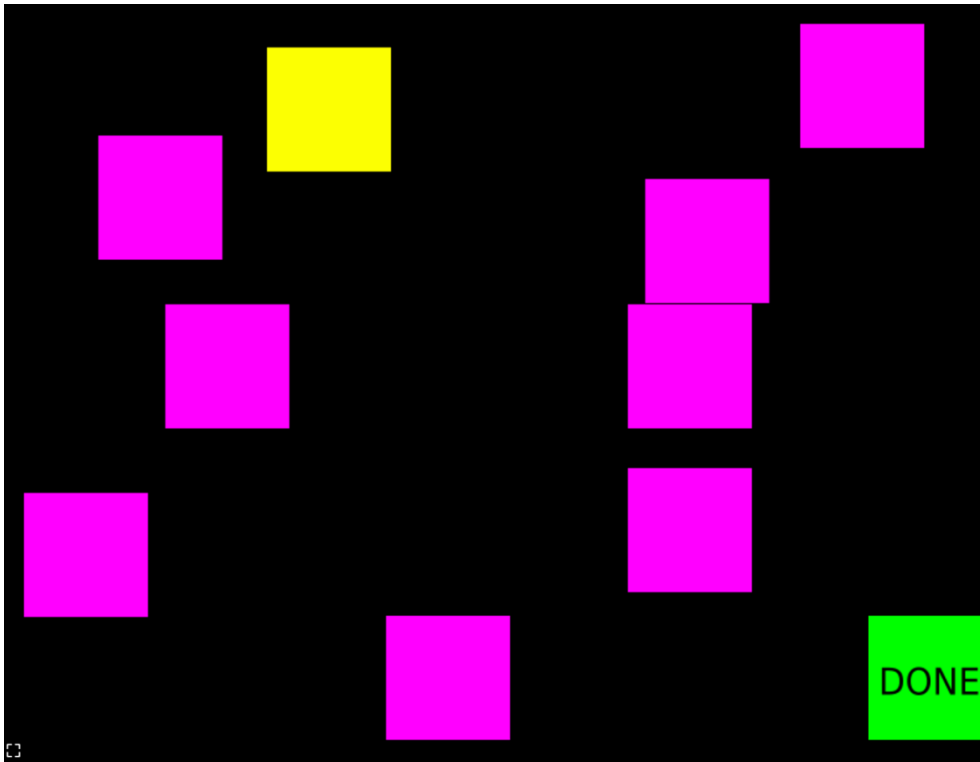


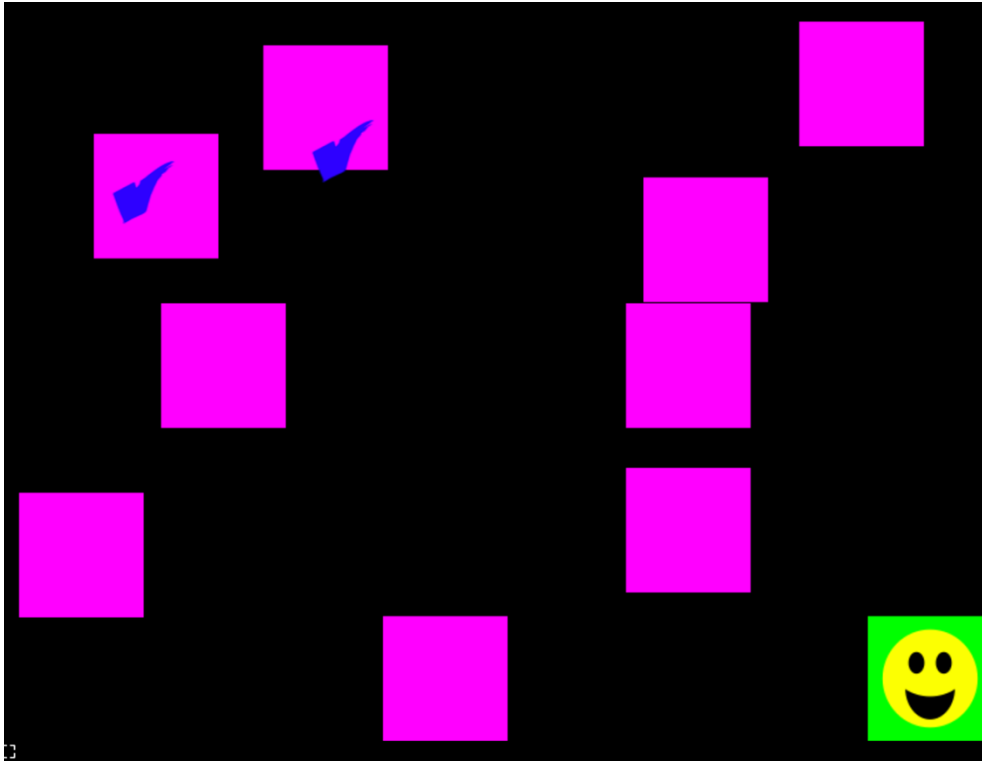


Example of Corsi Block-Tapping Test









APPENDIX D
SPSS OUTPUTS

1.0 Demographic Data Analysis

Frequency and Percentage of Participants' Gender

Gender

	Frequency	Percent
Valid Female	20	50.0
Male	20	50.0
Total	40	100.0

Frequency and Percentage of Participants' Race

Race

	Frequency	Percent
Valid Bumiputera Sabah	1	2.5
Bumiputera Sarawak	10	25.0
Chinese	20	50.0
Indian	2	5.0
Malay	7	17.5
Total	40	100.0

Frequency and Percentage of Participants' Age

Age

	Frequency	Percent
Valid 19 – 22 years old	23	57.5
23 – 26 years old	16	40.0
27 – 30 years old	1	2.5
Total	40	100.0

Frequency and Percentage of Participants' Faculty

Faculty

	Frequency	Percent
Valid Faculty of Applied and Creative Arts (FACA)	2	5.0
Faculty of Cognitive Sciences and Human Development (FCSHD)	19	47.5
Faculty of Computer Science and Information Technology (FCSIT)	5	12.5
Faculty of Economics and Business (FEB)	3	7.5
Faculty of Engineering (FENG)	5	12.5
Faculty of Medicine and Health Sciences (FMHS)	3	7.5
Faculty of Resource Science and Technology (FRST)	1	2.5

Faculty of Social Sciences and Humanities (FSSH)	2	5.0
Total	40	100.0

Frequency and Percentage of Participants' Year of Study

Year of Study

	Frequency	Percent
Valid Year 1	8	20.0
Year 2	8	20.0
Year 3	19	47.5
Year 4	5	12.5
Total	40	100.0

Frequency and Percentage of Participants' CGPA

CGPA

	Frequency	Percent
Valid 2.99 – 2.50	3	7.5
3.49 – 3.00	15	37.5
4.00 – 3.50	22	55.0
Total	40	100.0

2.0 Main Findings

Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Digit span (Total correct recall)	.147	40	.030	.950	40	.079
Total time taken to complete Digit Span Task (DST)	.140	40	.046	.949	40	.069
Corsi span (Total correct recall)	.219	40	<.001	.874	40	<.001
Total time taken to complete Corsi Block-Tapping Test	.116	40	.194	.953	40	.094

a. Lilliefors Significance Correction

Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	SD
Total Media Multitasking Score	40	14	33	23.65	4.938
Mean Media Multitasking Score	40	1.56	3.67	2.6278	.54870
Digit span (Total correct recall)	40	3	9	6.45	1.449
Total time taken to complete Digit Span Task (minutes)	40	02:04	05:05	03:32	00:54
Corsi span (Total correct recall)	40	3	8	6.20	1.418

Total time taken to complete Corsi	40	00:46	03:43	01:50	00:42
Block-Tapping Test (minutes)					
Valid N (likewise)	40				

Pearson Correlation

H₁: The Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Correct Recall

Correlations

		Media Multitasking Score	Digit span (Total correct recall)
Media Multitasking Score	Pearson Correlation	1	.571**
	Sig. (2-tailed)		<.001
	N	40	40
Digit span (Total correct recall)	Pearson Correlation	.571**	1
	Sig. (2-tailed)	<.001	
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

H₂: The Relationship Between Media Multitasking Habits and Verbal Working Memory Performance Based on Total Time Taken

Correlations

		Media Multitasking Score	Total time taken to complete DST
Media Multitasking Score	Pearson Correlation	1	.370*
	Sig. (2-tailed)		.019
	N	40	40
Total time taken to complete DST	Pearson Correlation	.370*	1
	Sig. (2-tailed)	.019	
	N	40	40

*, Correlation is significant at the 0.05 level (2-tailed).

H₄: The Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Time Taken

Correlations

		Media Multitasking Score	Total time taken to complete Corsi Block-Tapping Test
Media Multitasking Score	Pearson Correlation	1	.318*
	Sig. (2-tailed)		.046
	N	40	40
Pearson Correlation		.318*	1

Total time taken to complete Corsi Block-Tapping Test	Sig. (2-tailed)	.046	
	N	40	40

**. Correlation is significant at the 0.05 level (2-tailed).

Spearman's Rank-Order Correlation

H₃: The Relationship Between Media Multitasking Habits and Visuospatial Working Memory Performance Based on Total Correct Recall

Correlations

			Media Multitasking Score	Corsi span (Total correct recall)
Spearman's rho	Media	Correlation Coefficient	1.000	.518**
	Multitasking	Sig. (2-tailed)	.	<.001
	Score	N	40	40
	Corsi span	Correlation Coefficient	.518**	1.000
	(Total correct	Sig. (2-tailed)	<.001	.
	recall)	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed)