Faculty of Cognitive Sciences and Human Development

FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY

Choo Boon Linn

Bachelor of Science (Honours)

Cognitive Science

(2014)

UNIVERSITI MALAYSIA SAWARAK

Grade: _____

Please tick (√)
Final Year Project Report ☐
Masters ☐
PhD ☐

DECLARATION OF ORIGINAL WORK

This declaration is made on the 2nd day of June 2014.

Student's Declaration:

I   CHOO BOON LINN, 29914   from Faculty of Cognitive Sciences and Human Development (FCSHD) hereby declare that the work entitled, Factors Contributing to False Memory in Short Term Memory is my original work. I have not copied from any other students' work or from any other sources except where due   reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

2nd June 2014

_____   _____

       Date submitted   Choo Boon Linn(29914)

Supervisor's Declaration:

I   Dr. Tan Kock Wah hereby certifies that the work entitled, Factors Contributing to False Memory in Short Term Memory was prepared by the above named student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of Bachelor Degree (Honours) of Cognitive Sciences, and the aforementioned work, to the best of my knowledge, is the   said student's work

Received for examination by: _____   Date:_____
                                    (Dr. Tan Kock Wah)

I declare this Project/Thesis is classified as (Please tick (√)):

☐ **CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)*****
☐ **RESTRICTED** (Contains restricted information as specified by the organisation where research was done)*****
☐ **OPEN ACCESS**

Validation of Project/Thesis

I therefore duly affirmed with free consent and willingness declared that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abide interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies for the purpose of academic and research only and not for other purpose.
- The Centre for Academic Information Services has the lawful right to digitise the content to for the Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic exchange between Higher Learning Institute.
- No dispute or any claim shall arise from the student itself neither third party on this Project/Thesis once it becomes sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student except with UNIMAS permission.

Student's signature _____   Supervisor's signature: _____
                    (2nd June 2014)   (2nd June 2014)

Current Address:

_____

Notes: ***** If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the period and reasons of confidentiality and restriction.

[The instrument was duly prepared by The Centre for Academic Information Services]

FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY

CHOO BOON LINN

Projek ini merupakan salah satu keperluan untuk
Ijazah Sarjana Muda Sains dengan Kepujian
(Sains Kognitif)

Fakulti Sains Kognitif dan Pembangunan Manusia
UNIVERSITI MALAYSIA SARAWAK
(2014)

FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY

CHOO BOON LINN

This project is submitted in partial fulfilment of the requirements for a
Bachelor of Science with Honours
(Cognitive Sciences)

Faculty of Cognitive Sciences and Human Development
UNIVERSITI MALAYSIA SARAWAK
(2014)

Projek bertajuk 'Factors Contributing to False Memory in Short Term Memory' telah disediakan oleh Choo Boon Linn dan telah diserahkan kepada Fakulti Sains Kognitif dan Pembangunan Manusia sebagai memenuhi syarat untuk Ijazah Sarjana Muda Sains dengan Kepujian (Sains Kognitif)

Diterima untuk diperiksa oleh:

(Dr. Tan Kock Wah)

Tarikh:

2hb Jun 2014

Gred

The project entitled 'Factors Contributing to False Memory in Short Term Memory' was prepared by Choo Boon Linn and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Sciences)

Received for examination by:

(Dr. Tan Kock Wah)

Date:

2nd June 2014

Grade

ACKNOWLEDGEMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CGPA: Cumulative Grade Point Average

DNA: Deoxyribonucleic Acid

DRM paradigm: Deese–Roediger–McDermott paradigm

EM: East Malaysia

FMS: False Memory Syndrome

FMSF: False Memory Syndrome Foundation

FTT: Fuzzy Trace Theory

IBM: International Business Machines Corporation

LTM: Long Term Memory

SPSS: Statistical Package for the Social Sciences

STM: Short Term Memory

UNIMAS: University of Malaysia Sarawak

USA: United State of America

WM: West Malaysia

WMC: Working Memory Capacity

LIST OF PHOTOS

ABSTRACT

FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY

Choo Boon Linn

Bachelor of Science with Honors

(Cognitive Sciences)

2014

This research paper aims to conduct a survey on factors contributing to false memory in short term memory. The factors considered include CGPA, multiple intelligences and WMC. This study was inspired from the awareness of certain communities outside Malaysia in the False Memory Syndrome. The survey research will be carried out in two parts: pre-testing with five senior undergraduates and quantitative research with 65 senior undergraduates in the real survey research. The function of pre-testing is to investigate the precautions to be taken for actual test. In general, the findings from this research reported the existence of relationships between CGPA and false memory formations; and also relationship between WMC and false memory formation. Overall, it is believed that the occurrence of false memory can be reduced by improving the performance on related factors. The extent for application of the research result is subject to further study.

ABSTRAK

FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY

Choo Boon Linn

Ijazah Sarjana Muda dengan Kepujian

(Sains Kognitif)

2014

Kajian ini bertujuan untuk menjalankan suatu kaji selidik ke atas faktor-faktor yang menyebabkan memori palsu berlaku dalam memori jangka-pendek. Faktor-faktor yang telah dipertimbangkan termasuklah purata nilai gred kumulatif (PNGK), kepintaran berbagai dan kapasiti memori kerja. Kajian ini menerima motivasinya melalui beberapa komuniti di luar Malaysia yang menyedari dengan kewujudan Sindrom Memori Palsu. Kajian ini akan dibahagi kepada dua bahagian: kajian awal dengan menggunakan lima orang mahasiswa senior dan kajian berkuantiti sebenar dengan menggunakan 65 orang mahasiswa senior. Kajian awal diadakan untuk berfungsi sebagai pengenalan awal kepada langkah berjaga untuk diambil dalam kajian sebenar. Secara ringkasnya, pencarian dalam hasil dan analisa kajian ini telah mendapati kewujudan hubungan antara PNGK dengan memori palsu; dan hubungan antara kapasiti memori kerja dengan memori palsu. Secara keseluruhan, ianya dipercayai bahawa kekerapan memori palsu dapat dikurangkan dengan memperbaikan prestasi faktor-faktor yang berkenaan. Aplikasi hasil kajian masih merupakan subjek kepada kajian selanjutnya setakat ini.

CHAPTER 1

INTRODUCTION

1.0   Overview

This research is to establish study on the factors contributing to false memory in short term memory. The factors to be studied include: CGPA, multiple intelligences and working memory. In this section, the chapter is an introductory chapter which includes discussion on the background of research, the problem statements, the objectives, research questions, scope of the project research, significance of the research, and definitions of key terms.

1.1 Background/Context of the Research

At the moment, there is no definite knowledge attained about the mechanism of memory processing yet. To this, psychologists and cognitive scientists have been working hard to find a way for better processing and recording of memory, thus, the unknown about how and why memory fails started to turn into experts' quest and prickle their interest to find out more (Loftus & Pickrell, 1995).

The term 'false memory syndrome' (FMS) has then being introduced and came along into use in March 1992 when a group of parents in the United States who were experiencing accusations especially towards allegations on sexual abused have come together to build a non-profit-making organisation namely the False Memory Syndrome Foundation (FMSF) (Merskey, 1998).

According to The Innocence Project by USA, it has been found that 311 post-conviction DNA exonerations which include 18 people have been innocently put into death sentence (Hogenboom, 2013). This project is however, not the first finding claiming human are having false memory.

To date, there have been experiments running on research in the area of false memory, one of the very first and pioneer studies included the renowned Deese–Roediger–McDermott (DRM) paradigm, name invented for the technique of experiment on false memory by Deese in 1959 and Roediger and McDermott in 1995. The similar experiment with slight modification and add-ons that have been carried out by Roediger and McDermott in 1995 are having readily replicable results with the one Deese conducted in 1959 (Marian, 2005), The Deese-Roediger-McDermott paradigm is a word lists experiment (Cann, McRae, & Katz, 2011) with results demonstrating that people tend to mistakenly remember an item such as needle if they had been presented with related items such as thread and sharp (Johnson, 2001).

Another experiment that plays with the memory include the laboratory-based work by Bernstein and Loftus in 2005, which has uncovered false memory

for food-related experiences through repeated persuasion may result in attitudinal and behavioural impacts (Bernstein & Loftus, 2009). This may be name as the "False Memory Syndrome" (Marian, 2005), whereby lasting exposure to misinformation is capable of threatening one's long-term memory and caused the formation of false memory to be consolidated into the long term memory (Zhu, et al., 2011).

The research and experiments work on false memory have since being carried out in earnest which will be discussed in literature reviews which have been allocated into Chapter 2.

1.2   Problem Statement/Motivation of the Research

Memories have been a popular topic of discussion for decades, this is however, the actual mechanism for memories formation is still a subject for further investigation. Insight memories, there is the issue of memory distortion which arisen rapidly since the last two decades. Many patients who went for psychotherapy accused that their parents, grandparents, relatives and others have been sexually abused them. This has thus caught the attention of experts from related fields to start carrying out scientific work on false memory (Loftus, 1996).

False memory has becomes a subject that must be studied thoroughly especially when it comes to eyewitness's testimony that has been regarded as ironclad proof in court cases ever since centuries ago. This is because new researches in this area have showed that evidence through eyewitness testimony can be unreliable (Vitelli, 2012).

A lot of cases arisen from false memory can be traced, especially in the 1990s. The news can be found at the website of Chicago Tribune (Chicago Tribune, 2013). For instance, there are cases under Bill Smoler which have been able to defend the accusations of sexual abuse (Elbow, 2010), and these have again proved that testimonial in court may not be true all the time that even the

person who is giving the testimonial may not be able to differentiate one's false memory from actual memory.

Looking at the fact that issues related to false memory are somehow caused by the psychotherapists, Dr. Park Elliott Dietz who is a forensic psychiatrist has suggested that psychotherapeutic techniques must be having regulated standards during performance as it can be as powerful as other medical treatments (Ganga, 1994).

Meanwhile, it is found that similar research has not being carried out much in Malaysia yet. Thus, it is important to find out if cases such as above occur in Malaysia too. Positive outcomes of the research may be able to draw the awareness of Malaysians to the issues arising from false memory.

However, due to constraints from the aspect of time, status, location and sponsorship, this research is being scaled down to investigate the possible roots which may contribute to the formation of false memory in a university-undergraduate setting only. Although there have been almost similar research carried out by undergraduate students in oversea universities, this research is however being carried out in Malaysians context by consider the possible blending of our culture of education into the experiment may result in different outcomes comparing to the overseas. As known, Malaysians tend to memorize the knowledge first instead of learning by understanding only (Kember, 2000). This may influence the outcome of the survey.

The survey also looks into the attentional and perception ability as well as learning ability (skills) of a participant. These measurements may include academic performance (CGPA) and multiple intelligences of the subjects. These factors have been specifically pinpointed as they are something that can used to represent the individual differences in the participants.

1.3   Research Purpose, Objectives & Questions (Hypotheses)

Few variables which are being suspected as the potential factors of false memory formation have been considered in this research. They are to be examined on their relationships with false memory formation. Details are being discussed on the following sections.

1.3.1   General Objectives

This research is to study on the factors contributing to false memory.

1.3.2   Specific Objectives

A.   Cumulative Grade Point Average (CGPA)

    i.   Relationship:

➢ To study the relationship between CGPA and one's false memory formation.

B.   Multiple Intelligences (to False Memory Test in both Word Task vs. Picture Task)

    i.   Relationship:

•   *Verbal-linguistic intelligence to word task*

➢ To study if a student possessing higher verbal-linguistic intelligence scores better in the word task false memory test compared to those possessing lower verbal-linguistic intelligence.

•   *Visual-spatial intelligence to picture task*

➢ To study if a student possessing higher visual-spatial intelligence scores better in the picture task false memory test compared to those possessing lower visual-spatial intelligence.

C.   Working Memory Capacity (WMC)

   i.   Relationship:

➢ To study the relationship between working memory capacity and one's false memory formation.

1.3.3   Research Questions (Hypotheses)

No.	Null Hypothesis, Ho
1	There is no relationship between students' CGPA and false memory formation.
2	There is no association between verbal-linguistic intelligence (one of the multiple intelligences component) and false memory formation in word task.
3	There is no association between visual-spatial intelligence (one of the multiple intelligences component) and false memory formation in picture task.
4	There is no relationship between students' working memory capacity (WMC) and false memory formation.

Table 1.1: Hypotheses

1.4   Scope of the Research

This research gives focus to only three variables as the potential contributing factors to the formation of false memory in short term memory. They are:

- Cumulative grade point average (CGPA)
- Multiple intelligences
- Working memory capacity (WMC)

1.5 Significance of the Research

This research study aims to find out the factors contributing to false memory in short term memory. The factors that have been taken into consideration are: cumulative grade point average (CGPA), multiple intelligences and working memory capacity (WMC).

The outcomes from the research may suggest if these are the contributing factors to false memory formation and thus if they are, people may then focus on their weakness and involved in training such as practicing their working memory or improving their certain aspects of multiple intelligences so as to reduce their risks for the exposure to false memory formation.

1.6 Definitions of Key Terms/Concepts

The sections below will explain on the terms used in this research.

1.6.1 False Memory

False memory is a misinformation in memory which has been thought as true by the person. False memory can happen in both the short-term memory such as during the recognition tasks and long-term memory such as in the memory of past experiences (Freyd, 2011). The false memory test in this research involved false memory formation in short-term memory as subject to recognition tasks.

1.6.2 Cumulative Grade Point Average (CGPA)

CGPA is a student's mean of grades in the program up-to-date, weighted by credit points or hours (UCTI, 2010). While CGPA has always been used as a medium to measure one's intelligent, it is used as one of the predicted factor to false memory formation in this research.

1.6.3 Working Memory

Working memory is somehow being known as the drains of short-term memory to neuroscientists (Voytek, 2013). Although the two memories: short-term memory and working memory is often used interchangeably with working memory, but they shall be correctly used. This is because short-term memory mainly refers only as the temporary storage of information in brain memory. Meanwhile, working memory is different. It refers to the system that acts as a centre to process as simultaneous and temporary store for organize and handle information which is necessary especially for complex cognitive tasks which may include language comprehension, acquisition and reasoning. (Baddeley, 1992; Cherry, 2013b). It is alternatively known as memory span for its feature of having limitations to its capacity (Mastin, 2010).

Basically, working memory can be distributed into three sub-components:

1. Central executive: Responsible in attentional-controlling system
2. Visuo-spatial sketch pad: Manipulates visual images
3. Phonological loop: Stores and rehearse speech-based information which is necessary for the acquisition of language and vocabulary

(Baddeley, 1992)

There are limitations on working memory, such as:

1. Distraction: Any interruption may divert attention of a person and thus content in working memory is lost rapidly.
2. Too much information for remembering: Human brains are having limit in holding amount of information.
3. Engaging in a demanding task: Activities that require complex mental processing may reduce the space amount of working memory to function well.

(Gathercole & Alloway, 2007)

According to research, every individual possesses a personal limit for working memory, with each individual having a relatively fixed capacity that may

be greater or less than that of others, in average, most people working memory capacity is within the range of 7 ± 2 as a healthy adult (Gathercole & Alloway, 2007). There are several ways where working memory can be measured, these include: traditional digit span that visually or auditory presented, visual span for meaningless visual symbols and simple math span (Awh, 2013). As a highlight here, digit span will be used for this research.

In the next section, multiple intelligences which can represent one's talents or individual's cognitive skills and thoughts will be explained thoroughly.

1.6.4 Multiple Intelligences

Over time, the theory of multiple intelligences proposed by Howard Gardner in 1983 has been modified from seven (Wilson, 1997) to nine multiple intelligences (Gardner, 2013).

At the beginning, the multiple intelligences consist of: verbal-linguistic intelligence (word smart), mathematical-logical intelligence (number/reasoning smart), visual-spatial intelligence (picture smart), bodily-kinaesthetic intelligence (body smart), musical intelligence (music smart), interpersonal intelligence (people smart) and intrapersonal intelligence (self-smart). Later, it has been added up with naturalistic intelligence (nature smart) (Wilson, 1997). And up-to-date, it has been added in with another component: existential intelligence (Gardner, 2013).

The different components of intelligence pinpoint to different talent and ability:

Type of Intelligence	Explanation
Verbal-linguistic intelligence	Having well-developed verbal skills and able to utilise words and language to express meanings for oneself. People with high verbal-linguistic intelligence usually enjoy writing, reading, telling stories or doing crossword puzzles.
Mathematical-logical intelligence	Able to think conceptually and

	abstractly while good in calculate and reasoning with logical or numerical patterns. People with high mathematical-logical intelligence are drawn to arithmetic problems, strategy games and experiments.
Visual-spatial intelligence	Able to ponder in three dimensions, that is to visualize accurately and abstractly. Core abilities may include mental imagery, spatial reasoning, image manipulation, graphic and artistic skills, as well as active imagination. People with high visual-spatial intelligence may be captivated with mazes or jigsaw puzzles, or like to spend free time drawing or daydreaming.
Bodily-kinaesthetic intelligence	Able to handle objects and use a variety of physical skills nicely. People with high bodily-kinaesthetic intelligence possess great mind-body union.
Musical intelligence	Able to produce, reflect and recognise pitch, rhythm, timbre and tone. People with high musical intelligence usually enjoy singing or playing musical instruments.
Interpersonal intelligence	Able to portray empathy, detect, understand and respond to others' moods, motives and desires appropriately and thus effective in interacting with others both verbally and non-verbally. People with high interpersonal intelligence are mostly leaders among groups, good at communicating, and appear to be understanding.
Intrapersonal intelligence	Possesses self-awareness, which is able to capture one's personal or inner thoughts, feelings and values. This knowledge is used to plan and direct one's life. People with very high intrapersonal intelligence may be shy but they are very aware of their personal feelings and highly self-motivated.

Naturalistic intelligence	Able to distinguish and grouping nature creatures such as plants and animals as well as other nature objects and recognition to technology created in this modern world.
Existential intelligence	Thoughtfulness and aptitude to tackle deep questions about human existence (e.g. the meaning of life, why do we die, and how did we get here).

Table 1.2: Multiple intelligences

(Cherry, 2013a; Fleming, 2013)

Meanwhile, some educators and researchers think and suggested that multiple intelligences may have underlying the learning styles or learning preferences of an individual. However, according to Howard Gardner (2013), multiple intelligences are not learning styles. Intelligences may be improved after regular practice, for instance, ones able to speak a foreign language well after sometimes practising it. Meanwhile, a learning style refers to how an individual approaches the range of materials to learn. For this saying, multiple intelligences are different from learning styles (Strauss, 2013).

And as for note taking here, due to the fact that the ninth intelligence that has been proposed is still new and experts have not yet to form questions testing if one is good in existential intelligence, the questionnaires used for this research only covered the other eight intelligences that have been categorised above.

1.6.5 Summary on Definitions of Key Terms

While the above clearly explained the terms, the following summarised them into a simple table form:

Key Term	Definition
False memory	Incorrect imagination that is not happening in reality or untrue belief, that is, misinformation in memory. Have also been called as pseudo-memories and memory illusions. (Freyd, 2011)
Cumulative grade point average (CGPA)	A student's mean of grades in the program up-to-date, weighted by credit points or hours. (UCTI, 2010)
Working memory	System of memory described to function as a temporary center for both storage and manipulation of information especially for complex cognitive tasks. (Baddeley, 1992)
Multiple intelligences	Abilities and talents that one possesses. There are varies between individuals. One might be good in one and weak in another. There are nine intelligences being proposed: verbal-linguistic intelligence, mathematical-logical intelligence, visual-spatial intelligence, bodily-kinaesthetic intelligence, musical intelligence, interpersonal intelligence and intrapersonal intelligence, naturalistic intelligence and existential intelligence. (Gardner, 2013)

Table 1.3: Definitions for key terms

1.6.6 Conceptual Framework

Conceptual Framework:
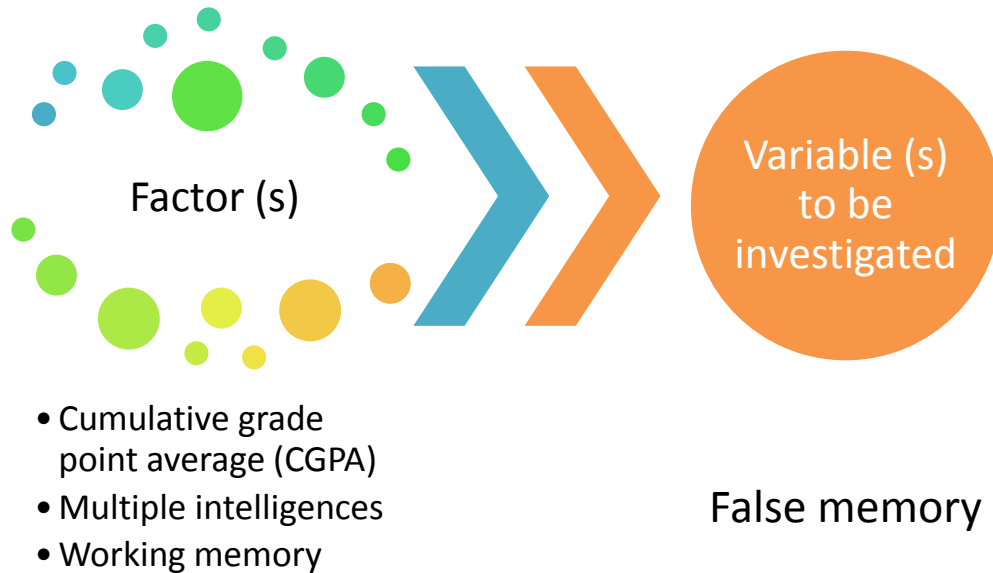
Figure 1.1: Conceptual framework

The research is to find out if the variables listed above may be the factors contributing to false memory in short term memory.

1.7 Chapter Summary

This chapter discussed about the overview of the research on factors contributing to false memory in short term memory. Background/context of the research, problem statement/motivation, research purpose, objectives and questions (hypotheses), scope of the research, significance of the research and definitions of key terms/concepts are explained in this section. The next chapter will be covered with related literature review.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0   Overview

This chapter is a literature review part which discusses on related literatures to the research. Topics on false memory and related theories will be mention in this chapter of dissertation as a supporting understanding to the research components.

2.1 Human Memory

It has been found out that human memory can be gone wrong in either the short-term memory or long-term memory. This means that false memory can be formed and packed into the state of short-term as well as long-term memories if rehearsal is done. Thus, we will have a little revise on human memory in this sub-section while insight to false memory will only be discussed in the next part.
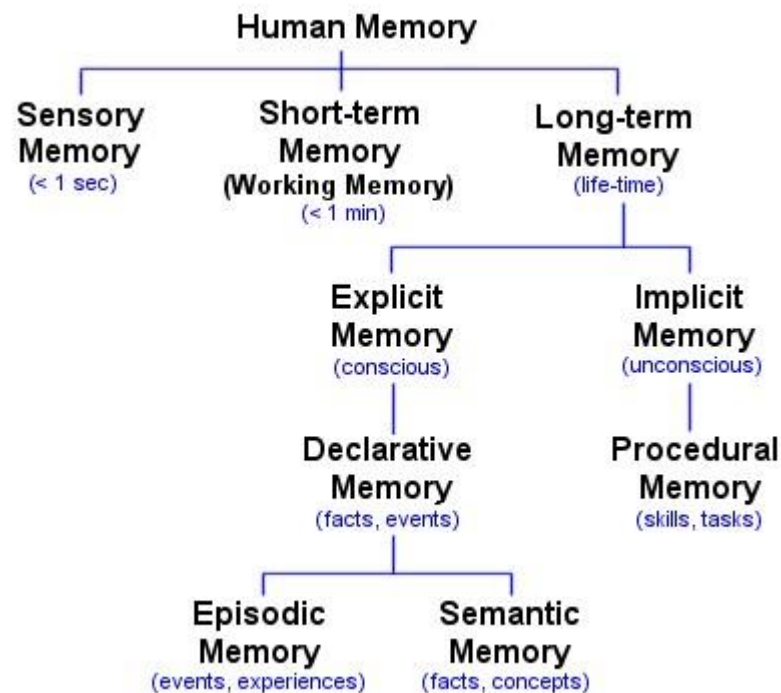
Figure 2.1: Human memory

(Mastin, 2010)

The Atkinson-Shiffrin model has been used widely for studying human memory ever since it was developed by Richard Atkinson and Richard Shiffrin in 1968. In the model, it states three necessary steps for human to successfully forming a long-lasting memory. The process includes: sensory memory, short-term memory (STM) and long-term memory (LTM) (Mastin, 2010).

The sensory memory is the memory element that acts to store the perception of stimuli before passing it to short-term memory. This memory may

decay less than a second and cannot be rehearsal. There are five types of stimuli which have been categorised and thus bring up the terms: iconic (visual) memory, echoic (aural) memory, haptic (touch) memory, olfactory (smell) memory and flavour (taste) memory (Mastin, 2010).

Meanwhile, short-term memory (STM) is known as a scratch pad for temporary recall of information. The short-term memory is responsible in holding and processing information at time. The working memory may somehow be used interchangeably with short-term memory, but there is a slight different between them. The short-term memory can be turning into long-term memory if rehearsal is done (Mastin, 2010).

Moving to the next phase, long-term memory (LTM) is a storage centre for information over a long period of time which stays strong if being rehearsed repeatedly and weaken if did not. Inside long term memory, it can further be distributed into explicit memory which we are having self-awareness and implicit memory which we are not aware of (Mastin, 2010).

Again, from there, implicit memory can be referred to procedural memory such as skills, breathing and peristalsis in intestines. On the other hand, explicit memory is to be further referred as declarative memory, which further being distributed into episodic and semantic memory. Episodic memory is the memory for emotional experience and autobiographical events while semantic memory refers to knowledge about external world (facts, meanings, concepts) (Mastin, 2010).

There are two more terms being introduced for long-term memory. They are:

1. Retrospective memory – Any long-term memory from the past.
2. Prospective memory – A memory that requiring "remembering to remember" which often triggered by a cue.

(Mastin, 2010)

After the understandings on human memory, we are now to look into false memory. Like mentioned above, false memory can be either formed in short-term

memory or even being consolidated into long-term memory. While DRM Paradigm is being used to test the false memory formation in short-term memory, false memory formation in long-term memory mostly occurred through the messing up with participants' prospective and episodic memories which are then inducing errors to cause retroactive interference. This is being done through the providing of cue to certain event or experience while delivering fault information to the event repeatedly to the subject. More detailed process of the tests can be reached at the sections below.

2.2   Introduction to False Memory

False memory is a state of memory that has been described as being mistakenly taken as a veridical representation of certain past event. The false memory can be range from relatively minor ways such as believing in one last saw the newspaper in the living room while it is actually in the bedroom to major ways such as falsely believe one has been lost in the shopping mall in one's childhood (Johnson, 2001). The false memory can be divided into two types: false recognition (conjoint recognition) which happens in short term memory and misinformation (conjoint misinformation) to long term memory (Brainerd & Reyna, 1998). Meanwhile, it is also being proved that people are prone to be exposed to or are susceptible to false memory. Further explanations by providing case study are written in the next section.

2.2.1   False Memory in Short Term Memory

False memory in short term memory may be taking place such as when we are using our working memory in recognition task. Experiments that proved the possible existence of false memory formation to short term memory include the Deese's (1959) word-list paradigm which later being revised by Roediger and McDermott in 1995, forming the name as the Deese-Roediger-McDermott paradigm. These experiments were being conducted by using blocks of list with

each word in the same list are semantically associated to a non-presented item. For example, words such as "bed, rest, tired and dream" are all associated with sleep. The participants are being asked to either write down or select the items presented (heard or saw) according to what they remember after each block of list. The results of the recognition task however showed that participants have often recalled or recognised the words that were never being presented in that particular block of list but may have appeared in the other block of list, otherwise were critical lures to the other list, or even words that never been appeared in any lists before (normal distractor) (Marian, 2005); or item that is in the same category to the block of list but never being presented (special distractor/ critical lure) (Jou & Flores, 2012).

However, the same rule did not apply to all the modals in DRM paradigm. For example, the longer and thus more distinct the critical word, the less likely it is to provoke a false recall in the test subject. This suggests that higher level of distinctiveness may contribute to a reduction in false recalling rate by simplifying the monitoring process during retrieval. Similarly, the modality of the test such as rate of word being showed; warning or without warning on critical lures; and auditory or visual presentation study can be a factor giving different outcome on the rate of false memory formation too (Silbermann, 2007). Following the claim by Johnson and Raye's (1981) that visual presentation leads to better reality monitoring, Robinson and Roediger (1997) whom tested participants by means of a computer reported that average probabilities of overall false recall is at only 0.31 as compared to 0.55 for 15-word lists that reported by Roediger and McDermott (1995). This has then made Smith and Hunt (1998) to suggest that visual presentation of the influential DRM paradigm allows more distinctive item-specific processing than auditory processing.

2.2.2 False Memory in Long Term Memory

False memory in long term memory may happen if repeated persuasion of misleading information is delivered. Experiments that showed the happening of false memory in long term memory include the great work by Elizabeth F. Loftus. Loftus has tried to intrude participants' memory of their childhood by stating if one has lost in the shopping mall as a child (Loftus & Pickrell, 1995) or one's preference towards food such as love the asparagus and get sick after eating egg salad repeatedly (Bernstein & Loftus, 2009). And after a few interviews, it has been found out that most of the participants started to believe the misinformation as truth and this is where false memory formed. For example, one has been put into belief he was lost in the shopping mall as a child, or, avoiding the consumption on egg salad and willing to taste the asparagus.

The technique used here is name as misinformation paradigm, a model which giving misleading information to the participants regarding certain events (Zhu B. , Chen, Loftus, Lin, & Dong, 2013).

As detailed description on the findings in this area, a case study will be explained here. Stephen Lindsay, a cognitive psychologist from the University of Victoria, British Columbia, along with researcher Lisa Hagen have leaded a project to carry out research about false memory on college students. Knowing that clinicians have been using old family photos to help trauma patients with memories, Lindsay and Hagen had tried to find out if old photos may on the other hand stimulate memories that never occurred (Dye, 2013).

In the research, college students were asked if they recalled a prank they did on their first grade teacher. Some of the students were shown with the class photo with the teacher in the first grade while some were not. Result showed that the students who were shown the photos are having surprising clarity of recall about the prank while most of those who were not shown the photo did not. It has been suggested that this is happened due to the reason that photos may have play a role in refreshing the memory of real people they connected in the past, as well as

facilitating the formation of vivid yet fantasy images of pseudo-event for the past (Dye, 2013).

2.2.3   New Technologies to Study on False Memory

Recently, new technologies such as Transcranial Magnetic Stimulation (TMS) and transcranial Direct Current Stimulation (tDCS) have been introduced to the area of study in memory and cognition. With the help of these technologies, researchers are capable of gaining better insight into the neurological basis for false memory. A recent study using these technologies along with the DRM paradigm has shown that stimulation in the anterior temporal lobe is capable of reducing the susceptibility to false memory (Boggio, et al., 2009).

2.3   False Memory and Related Researches

This part will introduce and briefing through selected research findings that closely related to false memory formation and its factors.

2.3.1   CGPA and False Memory

A research carried out by Platt, Harsh and Neuschatz (2000) has showed that SAT (a test on the academic skills of students which is being used for admission to US colleges) and Grade-Point Average (GPA) are able to predict one's false memory formation in the DRM paradigm. It has thus inferred that people with higher intelligence (which assumed by measuring the academic performance) possess better capability in rejecting false memory (Platt, Harsh, & Neuschatz, 2000).

Similarly, in the research conducted by Harsh (2001) showed the common result with the academic performance were discovered to be strongly predicting one's performance in the DRM task with warning about critical lures given. From

the result, it is said that individuals with high academic performance is better in recognition and recall (Harsh, 2001).

2.3.2 Working Memory Capacity (WMC) and False Memory

Several studies have found out that individuals with low WMC span scores are weaker in suppressing irrelevant information and vice versa whether with or without warnings on critical lures (Conway & Engle, 1994).

Working memory is used by individual to maintain and manipulate information for a brief time (Miyake & Shah, 1999). According to Kane and Engle (2002), attentional control is regard as the primary function in working memory. Thus, working memory tasks can be used to measure executive attention, an ability to actively maintain goal-oriented during the tasks (Kane & Engle, 2002) and able to resolve the interference evolved from the tasks and predominant response (McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010). This argument has then suggested that there is a relationship between WMC and long-term memory (McCabe, 2008).

In conjunction with the suggestion, research studies have revealed that individuals with low WMC not only have higher rates of false memory formation in the DRM paradigm (false recall), but also in the misinformation paradigm (wrong event information) (Leding, 2012). This can be explained by saying that individuals who are possessing better WMC are much well handling with source monitoring and accurate retrieval of memory in order to reduce memory errors (Unsworth & Brewer, 2010).

Hence, using the perspective from attentional control stated above, one may expect individual differences in WMC may contribute to different performance outcome of cognitively challenging tasks such as taking the DRM paradigm (Watson, Bunting, Poole, & Conway, 2005).

2.3.3 Multiple Intelligences and False Memory

There is no an exact study conducted under this category yet. However, it has been found out that there are a few closely related researches existed at the moment. For instance, Tousignant has disclosed that individuals who prefer visualization to verbalization are less subject to false memory from his findings in 1984. This has contradicted with the study conducted by Platt et al. (2000) that found no correlation between performance on the DRM and types of learners.

On the other hand, Mayer and Massa (2003) has made a hypothesis that verbal learners and visual learners may have different cognitive styles, learning preferences, spatial ability and general achievement. However, it was then found out that cognitive styles of learners did not correlate significantly to the measure of other variables (Mayer & Massa, 2003). This has contradicted with the research by Riding and Watts (1997) that discovered that verbalizers lean towards verbal instruction, whereas visualizers lean towards pictorial instruction during classroom learning task (Riding & Watts, 1997).

Alternatively, there was another research that tested on the correlation between false memory with intelligence, perception, memory and face judgment. The tests used to measure included:

- Intelligence
    - Raven's Advanced Progressive Matrices and Wechsler Adult Intelligence Scale
- Perception
    - Motor-Free Visual Perception Test, Change Blindness, and Tone Discrimination
- Memory
    - Wechsler Memory Scales and 2-back Working Memory tasks
- Face judgments
    - Face Recognition and Facial Expression Recognition

Results from the test showed that false memory formation is significantly and negatively correlated to all the variables above. These could suggest that individuals with lower scores in the variables above might be more susceptible to the misinformation effect (Zhu B. , et al., 2010).

2.4   Theories Proposed for False Memory (Theoretical Framework)

This part will stress on the underlying theories suggested to the formation of false memory.

As known, a memory process consists of four stages: encoding, consolidation, storage and retrieval, thus we shall expect false memory to go through the similar processes too (Straube, 2012). There have been different theories proposed respectively for the states of encoding, consolidation and retrieval. These are discussed below.

2.4.1   Encoding State

Encoding is a state or process where information we received from our sensory input is changed into the form the mind can cope with in order to be stored (McLeod, 2007). The underlying theories proposed for false memory in this state included: visual imagery hypothesis, semantic network theories (which include spreading activation theory and fuzzy trace theory) and top down processes.

A)   Visual Imagery Hypothesis

Visual imagery hypothesis has stated that false memory may be produced due to the encoding of imagination events which were thought as true by the mind. This theory was proposed due to the evidence from fMRI studies which disclosed that falsely remembered words are capable of activating the precuneus and left

inferior parietal cortex which involved in visual imagery tasks (Gonsalves, Reber, Gitelman, Parrish, Mesulam, & Paller, 2004). Meanwhile, both the true and false memories activate the hippocampus during encoding (Baym & Gonsalves, 2010). The theory suggests that false memory may be due to the result of confusion between the imagined events which stimulate the visual processing areas with the activation of visual cortex which induced by optic nerve. The resulted visual memories are thus may be some false memories which have been subsequently encoded. This theory suggests the reason of false memory formation in both the long-term and short-term memories.

B)   Semantic Network Theories

Inside brain's encoding process for semantic network, there are two theories which have been suggesting that false memory formation is an accidental consequence during the process of semantic encoding (Straube, 2012). This suggestion has further being supported when Kim and Cabea found out that left prefrontal cortex which usually associated with semantic processing got activated in both the encoding of true and false memories (Kim & Cabeza, 2007). These theories included: spreading activation theory and fuzzy trace theory (Straube, 2012).

i)   Spreading Activation Theory

This theory states that while ones is being presented with words, semantic network activation may lead to the spreading of presented words to semantically related words unintentionally and being mistakenly encoded. This explains why people having false memories of critical lures in the DRM paradigm (Balota & Duchek, 1989).

This theory will be tested in this research using false memory test, or namely DRM paradigm.

ii)   Fuzzy Trace Theory

Fuzzy-Trace Theory (FTT) is a memory model which has been most widely recognised to describe the counterintuitive findings between memory and higher reasoning processes (Brainerd & Reyna, 2002) although the original Fuzzy Trace Theory (FTT) shall composed of seven basic principles: gist extraction (reduction to essence rule), fuzzy-to-verbatim continua, fuzzy processing preference (intuition), reconstruction in short-term and long-term memory, output interference, resource freedom, ontogenesis (Brainerd & Reyna, 1990).

This theory is popular and widely accepted to explain on false memory because of its concepts of identity, non-identity and similarity judgments have provided an integrated account of the false-memory phenomena which included the false-recognition effects and misinformation effects. False-recognition effects are a condition where similarity or false identity judgement on distractors that preserve the meaning of presented targets is increased while non-identity judgement is decreased. Meanwhile, misinformation effects are a condition where one wrongly accepted the misleading information on past events while rejected that of the actual events (Brainerd & Reyna, 1998).

FTT has then suggested that there are two opponent memory representations formed in our mind (Otgaar, Alberts, & Cuppens, 2012):

- Verbatim   traces: word-for-word,   remembering   things   exactly (Loepelmann, 2008) (such as the experience of an event)
    - Disrupted memory that occur within this line is known as misinformation (conjoint misinformation) which may give side effect of false memory to long term memory (Brainerd & Reyna, 1998)

- Gist traces: remembering the general meaning of things (Loepelmann, 2008) (such as surface characteristic of an experience)
    - Distorted memory that occur within this is known as false recognition (conjoint recognition) whereby false memory is more

probably to happen in short term memory (Brainerd & Reyna, 1998)

The general summary which can be made according to the high number of experiments conducted before the proposing of the FTT is: original memory can be distorted by lots of factors such as cognitive dissonance, consistency bias and misattribution. This may later be influencing one's thought and behaviour (Dean, 2008).

This theory, on the other hand, identifies that inability to detach both verbatim and gist traces during encoding resulted in the formation of false memory. This has thus explains participants inaccurate retrieval of non-presented gist words in DRM paradigm test (Brainerd & Reyna, 2002).

C)   Top-Down Processes

It has been said that bottom-up processing is the lead to the factors of false memory production. This is however, top-down processing of presented items has more powerful effect to the happening of false memory. One study has shown that low-arousal mood participants are having higher recollection of false memories than those who are high-arousal mood. This may due to the reason that one heightens the strength of verbatim traces during the encoding (Van, 2012).

Meanwhile, there has also been another study which found out that negative affect is capable of decreasing the formation of false memory in the similar way that high-arousal does (Storbeck, 2013). These studies have on the other end contributing to evidence that there is an interaction in between amyglada and hippocampus in false memory formation.

Further study included the finding that working memory capacity is inversely related to the formation of false memory under the condition of forewarn when DRM paradigm is applied. It has also been said that, lifestyle and

stress have been playing effect on the top-down processing of memory too (Bixter & Daniel, 2013). Stress has been known to be capable of making interference to the encoding (Institut universitaire en santé mentale de Montré, 2013).

Likewise, in this research, participants are to be forewarn about the presence of critical lures and distractors in the DRM paradigm, whereby the acknowledgement will contribute to a top-down processing which the participants may pay extra attention to the words presented.

2.4.2 Consolidation State

Consolidation is a state where memory traces are being stabilised after the initial acquisition. It is thought to be a part of the encoding and storage process (Mastin, 2010). The underlying theories proposed for false memory in this state included: interference theory and sleep deprivation.

A) Interference Theory

Interference theory gives explanation on internal processing of an individual. There are two types of interference in this theory: retroactive interference and proactive interference (Underwood & Postman, 1960).

i) Retroactive Interference

Retroactive interference is a condition which newly learned information interferes with previously learned information (Eysenck & Keane, 2005). Retroactive interference can be seen from the misinformation paradigm, a model which used to give misleading information about original memory on past event. The misleading information will then lead to a reconsolidation of the inaccurate memory (Howe, 1998). This phenomenon is referred as false memory in long-term memory. Alternatively, in the DRM paradigm, the critical lures and

distractors seen in the selection list may too be interfering with the words presented, and thus leading to a wrong selection of choice in the test. This is the point proving the existence of false memory in short-term memory.

ii)   Proactive Interference

Proactive interference is a condition which past memories inhibit new learning (Eysenck & Keane, 2005). This condition can be seen if a person sitting for DRM paradigm chosen distractors that were part of previous set of list.

B)   Sleep Deprivation

Sleep has always been known as crucial to stabilize and strengthening the new memories while responsible in consolidating the memories into long-term storage (Straube, 2012). In a study, it has been found that sleep actually enhance both false and true memories. This suggests that sleep tends to consolidate memories regardless of true or false (Darsaud, et al., 2011). Similarly, in another study, it is found that false memory was being enhanced in individuals no matter if the individual was having nocturnal sleep or sleep deprivation (Diekelmann, Born, & Wagner, 2010).

However, sleep deprivation is not a part of the factors to false memory formation that is to be covered or measure in this research.

2.4.3   Retrieval State

Retrieval is a state of process where the brain is to access or obtaining information from the storage (McLeod, 2007). The underlying theories proposed for false memory in this state included: retrieval cues, activation monitoring theory and sensory reactivation hypothesis.

A)   Retrieval Cues

During retrieval, memories are prone to distortion. This has been shown by misinformation paradigm whereby retrieval cue has been capable of putting a significant impact on details of memory that is to be retrieved under the repeated misleading of researchers to the participants (Straube, 2012). This cue is then able to cause to the happening of retroactive interference (Loftus & Palmer, 1974) which is more likely to happen to long-term memory.

B)   Activation Monitoring Theory

This theory relates the spreading activation theory into the context of retrieval process. Source of activation can be determined when the spreading activation of semantic networks is having a monitoring process during retrieval (Straube, 2012). If the monitoring process is disturbed and source of activation no longer differentiable, it indicates the happening of false memory formation. For example, one is having confused memories for critical lures in the DRM paradigm (McConnell & Hunt, 2007). The outcome of this research study will either be further supporting this theory or opposes it.

C)   Sensory Reactivation Hypothesis

Certain fMRI research suggested that activation of sensory perceptual regions during retrieval play the role to distinguish between true and false memories as supported by this hypothesis of sensory reactivation (Straube, 2012). This hypothesis has stated that memory retrieval induces a reactivation to the cortex areas that is responsible in the perception during encoding (Stark, Okado, & Loftus, 2010). However, this hypothesis cannot be tested in the study as this research does not include the use of any medical imaging device.

2.5 Summary and Discussion

While previously, the existence of false memory was only being discussed by the psychologists and cognitive scientists, the research on false memory has soon being brought up to a whole new level by neuroscientists too. Below illustrates one of the latest findings by neuroscientists on false memory.

2.5.1 Proving the Existence of False Memory by Neuroscientist

Knowing that memories are being formed and activated in the forms of light and hormones, another one of the latest findings in neuroscience which conducted by MIT has further proven the existence of false memory. The finding has been successfully proven in two studies. In the first study, researchers have engineered the hippocampal cells of the mice to express the gene for channelrhodopsin which will get activated when light stimulation is received. They have as well modified the gene to produce channelrhodopsin whenever the c-fos gene that responsible for memory formation is active (Trafton, 2013).

These engineered mice are then conditioned to fear a particular chamber whereby the researchers were delivering them a mild electric shock there. The mice were then being moved to another chamber the next day. They were behaved normally. However, when researchers delivers light pulse to the hippocampus in order to stimulate the memory cells labelled channelrhodopsin by using optogenesis, the mice froze in fear due to the reactivation of previous day's memory (Trafton, 2013).
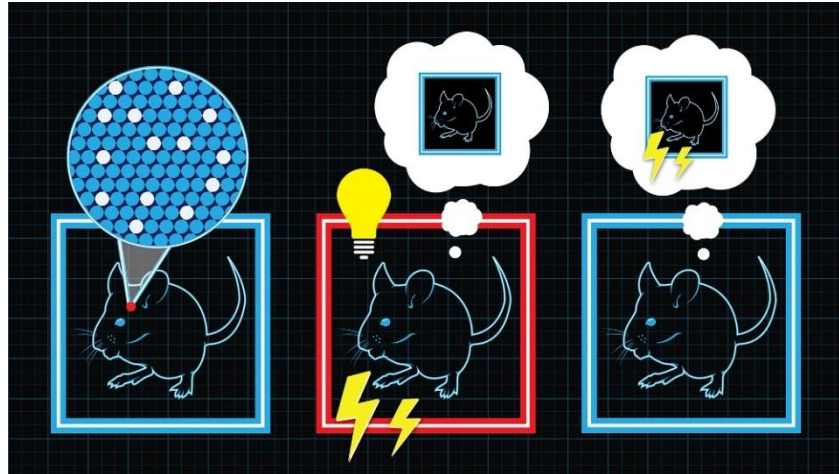
Figure 2.2: False memories implantation in mice

The figure above has illustrated the second study of the findings. In the second study, the mice were having their hippocampal cells modified and engineered such as that in the first study. This time, however, the mice were first being placed in Chamber A without electric shock. Then, they were moved into Chamber B the next day and received mild foot shock. On the other side, the researchers have delivered light to activate the encoded memory cells of Chamber A on the spot of the current shock too. These mice were then being placed back to Chamber A and it has been found out that these mice were froze in fear. This proved that false memory has been incepted. (Trafton, 2013).

In general, we can see that the same brain cells may be able to fire the same way to create events' illusions which have never occurred before and thus forming hallucinations under the condition of sufficient manipulation (Kluger, 2013).

As a summary to the discussed above, it is now to relate the reasons to the question "If the phenomenon of false memory formation occurs in Malaysians, particularly undergraduates too?". Based on the proposed idea, this research is to survey on the happening of false memory formation in short-term memory task using the DRM paradigm and its potential factors which include: CGPA, working memory capacity and multiple intelligences. But first, we will look into the theories explaining false memory formation in short-term memory.

2.5.2   Encoding State and False Memory Formation

In the encoding stage, the Visual Imagery Hypothesis suggests that falsely remembered or imagined words would lead to the encoding of both the true and false memories which the confusion subsequently cause the formation of false memory. Meanwhile, in the Semantic Network Theories, Spreading Activation Theory suggests that during the presentation of words, one may unintentionally encoded the semantically related words during the spreading activation. Similarly in the Semantic Network Theories, Fuzzy Trace Theory suggestion on gist traces pointed that one would easily remembering the general meaning of things during the memorization and recognition task. And when one becomes unable to separate between verbatim traces and gist traces, false memory is formed. Also, since that the participants of this research will being foreworn on critical lures and distractors in the DRM paradigm, this provide them with a top-down processing while sitting in the false memory test.

2.5.3   Consolidation State and False Memory Formation

During the consolidation stage, as known, sleep promotes memory consolidation, however, due to time constraint, sleep or long rest is not being considered to be placed within the test. Moreover, repetition of words study is not allowed in the test. This has thus not providing enough periods for the memory to be fixed into long-term memory, and hence, the new short-term memory could be fragile and susceptible to both retroactive and proactive interferences (Eysenck & Keane, 2005).

Retroactive interference is said to be happened when the participant wrongly chosen the selection after seeing the list of choice which consists of not only the presented words, but also critical lures and distractors in the DRM paradigm. The newly presented list has interfered with the words one has learnt a moment ago. On the other hand, proactive interference is said to be happened

when one chosen distractors that were part of previous set of list in the DRM paradigm.

2.5.4   Retrieval State and False Memory Formation

Meanwhile, for retrieval stage, Activation Monitoring Theory has pointed that confused memories as stated in the Spreading Activation Theory are capable of disturbing the monitoring process and cause the formation of false memory when the source of activation is no longer differentiable. This explains of subject preference on the selection of critical lures during the false memory test. Following these established ideas, we can hypothesize that false memory formation would occur in Malaysians too, even if it was the top scholar.

2.5.5   False Memory Formation and Potential Factors

2.5.5.1 False Memory Formation and CGPA

As previously discussed, it is said that individuals with high academic performance is better in recognition and recall, thus CGPA has been used in this test as an indicator to academic performance. The test is to survey if individuals with better academic performance tend to be more efficient in eliminating the happening of false memory.

2.5.5.2 False Memory Formation and WMC

Based on the review, it has been found out that most studies have concluded that individuals with higher WMC are more capable of suppressing irrelevant information and vice versa. This may due to the fact that they possess better attentional control (monitoring) which provides them with the ability to maintain goal-oriented during the recognition and retrieval tasks while hardly get affected by interference.

2.5.5.3 False Memory Formation and Multiple Intelligences

On the other hand, while past research studies have found relationships between false memory with academic performances, WMC, intelligence, and perception, memory and face judgment, we may want to hypothesize that there are other variables that could contribute to differences in false memory formation too (Hunt, 1980). For examples: ages, gender, mood, ego, metacognition, personality, absorption and mental imagery, field independence, levels of creativity and etc. which have been conducted in other research studies that did not being mentioned in this report.

Although there is no previous study of false memory formation that considers this factor of multiple intelligences yet, we shall not exclude any possibilities to be a factor influencing one's false memory formation even no prior studies have been examined on the variables yet. To this point, standardized multiple intelligences questionnaires will be used in this proposed research instead of learning styles questionnaires. While there is a research stating that verbalizers lean towards verbal instruction, whereas visualizers lean towards pictorial instruction, this research proposes to search on the relationship between verbal-linguistics intelligence with false memory formation (word task) and visual-spatial intelligence with false memory formation (picture task).

Lastly, relationships between the proposed variables might also being investigated along during the analysis of data as an aim of the current study include to uncover any possible relationship exist which could be an underlying issue to false memory formation.

2.6 Chapter Summary

This chapter discussed and reviewed about the literatures related to this research. The topics included human memory; introduction to false memory; new technologies to study on false memory; false memory and related researches; theories proposed for false memory (theoretical framework); and latest findings. These will help in giving further understanding to the works in this area of research.

The next chapter will be discuss on methodology and procedures used in this research.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.0   Overview

This chapter explains the methodology used in carrying out the research. Methods employed to set up and analyse the research is being portrayed in this chapter.

3.1   Introduction to Research Methodology

Research methodology is defined as a way to resolve the research problem systematically and scientifically, such as in this research, using the analysis generated by the IBM SPSS Statistics software. To be able to achieve the aims of the research, one not only has to understand the research methodology, but also to know the research methods or techniques to be used. In short, to score a positive research outcome, the researcher is required to understand the procedures and instruments used for the research (Kothari, 1990).

3.2   Design of the Research (Conceptual Framework)

All parts in this survey research are computer-based: Online questionnaires for multiple intelligences test, online test for working memory and cognition laboratory online application to test for false memory. The result of all participants will be being print screen and pasted into the Ms Word file along with their latest CGPA being recorded.

There are numbers of websites with the same standardised questionnaires and tests available. However, only one shall be chosen and is being listed as below:

- The false memory test can be accessed at:
  http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition/falsememory_instructions.html

- The multiple intelligences test can be accessed at:
  http://www.edutopia.org/multiple-intelligences-learning-styles-quiz

- The working memory test can be accessed at:
  http://www.gocognitive.net/sites/default/files/stm.v1.0.a_1_0.swf

3.3   Sampling Procedure of the Research

The experimental research proposed will be divided into two parts: pre-test research and quantitative post-test research. The function of the pre-test is only to test if the planned tests (instruments) are suitable to be used in the actual test. This is to check out on time factor or any special circumstance that may be found from the tests.

Meanwhile, no matter is it of social research, medical research or marketing research, it is found that there is no exact guideline in determining the sample size as it is considered not relatively important in a qualitative research (Mason, 2010; Ajjawi,2013; DePaulo, 2000). However, possessing no previous experience in memory research, a cognitive science student shall be able to relate at least a solid principle to estimate the right sample size for a qualitative research based on the knowledge acquired previously. Thus, the knowledge on human-computer interaction which is the heuristics evaluation, also known as usability testing has been implemented into the situation to solve the issue faced.

According to Jakob Nielsen (1995), severity rating from single evaluator may be biased and thus unreliable. Also, heuristic evaluation that is to be evaluated by multiple evaluators will become more effective (Sauro, 2010) as different evaluators may be able to find out different problems of an interface (Chisnell, 2010). In fact, to achieve a result that is satisfying and practical, ratings from three to five evaluators would be ideal (Nielsen, 1995).

Following the above, five random subjects of university senior student will be invited spontaneously and randomly in West Malaysia as the pre-testing participants for the similar experiment in order to investigate precautions to be taken for actual test. Soon after the pre-testing, the research proceeds by randomly selecting 65 students from University Malaysia Sarawak who is currently at least in their second semester of undergraduate studies using criterion sampling. Criterion sampling is a sampling technique that selecting cases or subjects based on some predetermined criteria (Cohen & Crabtree, 2006), whereby in this project, the participants must be at least second semester undergraduates. This criterion is

being weighed seriously so as to get the CGPA score in university of the involved participants.

A sample size of 65 undergraduates is selected for the quantitative post-test research as if all of the three factors (CGPA, WMC and multiple intelligences) proposed are possessing a relationship with false memory formation, then a multiple regression analysis can be done to predict which is better in predicting the rate of false memory formation. This sample size is established by following the rule of 20:1 or using the equation formula of n = (v-1) x 20 (Burmeister & Aitken, 2011). Thus, since there are a total of four variables (including the variable "false memory formation"), at least 60 participants are required in the study. However, to ensure the number of participants is sufficient and efficient in predicting the population, as well as a precaution to prepare for invalid data by participants due to unexpected error, a self-consideration for adding up of extra 5 individuals to the total participants needed is taken into concern, turning the sample size for the actual test to be 65 participants.

The participants will be carrying out the tests in computer laboratory or any location that is comfortable and convenience; and equipped with chairs and tables. The participants will be using the researcher's personal laptop that equipped with internet access through broadband or wireless internet.

The active experiment conduction can be partitioned into four parts:

1. Filling personal data such as name, years of study, faculty and most importantly, cumulative grade point average (CGPA).
2. Answering the online questionnaires for multiple intelligences test.
3. Doing the online working memory test.
4. Doing the online false memory test (with warnings about critical lures).

All the results of participants will be print screen and recorded into the personal word file allocated for each participant. Later, IBM SPSS Statistics software is used to enter the data for interpretation. Analysis and conclusions or inferences will be made during finalization.

The main idea of the research is being delivered in the operational framework below:
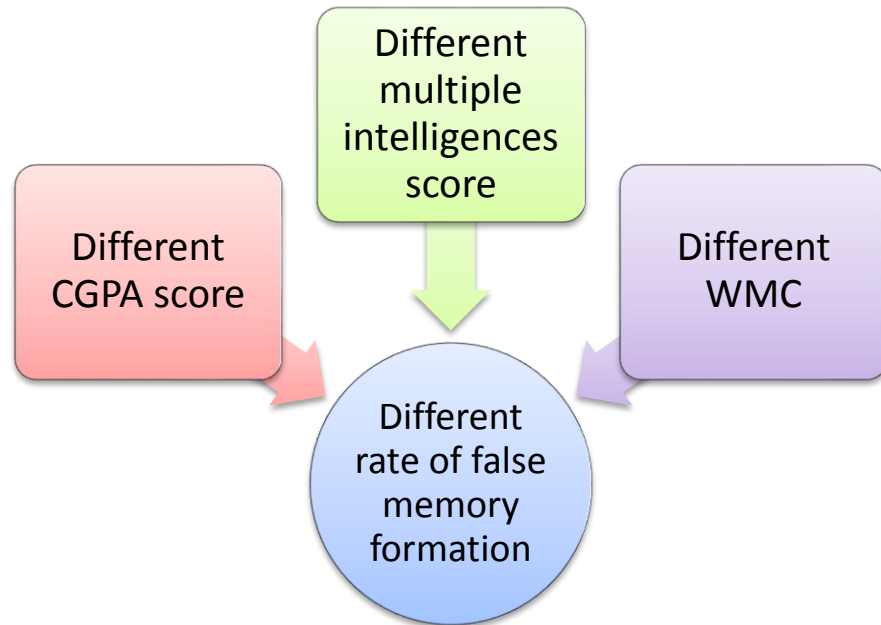
Figure 3.1: Operational framework

Alternatively, the procedures of the whole research can generally be summarised in the research framework such as below:
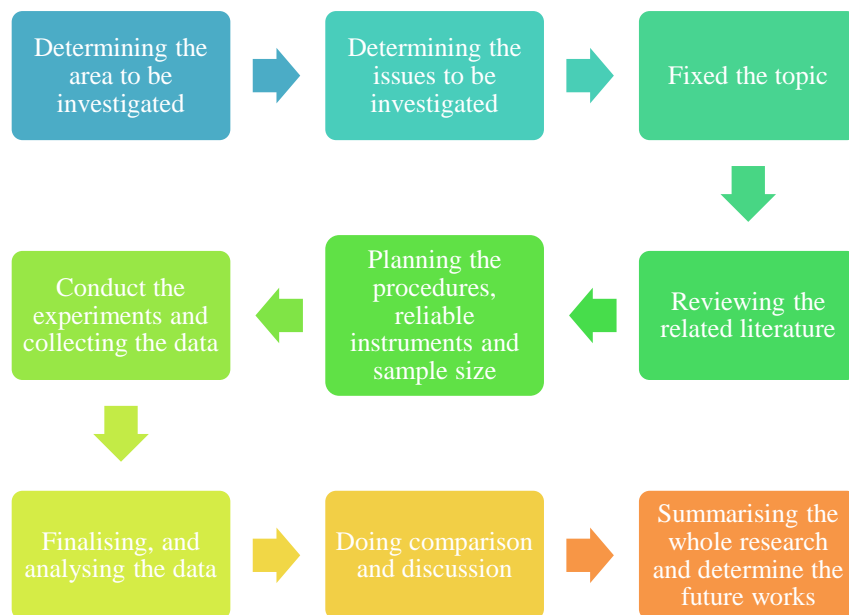
Figure 3.2: Research framework

3.4   Instrumentation and Reliability & Validity of Instruments for the Research

This section will be discussing on the instruments; and reliability and validity of the instruments used for the research.

3.4.1   Instrument for Multiple Intelligences Test

This test is a set of questionnaire consisting of 24 inquiries related to daily activities and interests. For each questions, participants are to identified and answer them based on their first thought. The results will be generated and show in percentage for each category of intelligence.

The test can be reached online at:

http://www.edutopia.org/multiple-intelligences-learning-styles-quiz

3.4.1.1 Validity and Reliability of Multiple Intelligences Test

Discussing on the reliability and validity, multiple intelligences test is a set of standardised questionnaires which was set up under the collaboration of a group of researchers and psychologists based on the theory proposed by Howard Gardner in 1983 (Cherry, 2013). The Edutopia website has been chosen for this test.

Edutopia is a website under the George Lucas Educational Foundation in San Rafael, California, United States. It has been a vision of the organisation to build a better learning place for everyone and they choose only qualified personnel or professional to write in the website.

The website is also being chosen due to the reason that the results generated will be shown in percentage for each category of intelligence. This will ease the researcher with an accurate representation of the results.

3.4.2   Instrument for Working Memory Test

This test is a pre-programmed application to test the work memory capacity. This can be accessed in multiple ways: traditional digit-span that being visually presented along with or without auditory pronunciation based on individual's preference; visual span for meaningless visual symbols; and simple math span.

However, in the experiment, every participant just being required to take the visually presented traditional digit span test along with auditory pronunciation under the default setting of 2 seconds display for each digit and to starts at 5 digits. Every failure will decrease the digits by a number or level. After an average can be calculated, the test ends. The results will be generated and show in number of digit span ones can hold, which indicates the working memory capacity.

The test can be reached online at:

http://www.gocognitive.net/sites/default/files/stm.v1.0.a_1_0.swf

3.4.2.1 Validity and Reliability of Working Memory Test

Working memory test was originally developed by Daneman and Carpenter in 1980 and soon being expanded by Just and Carpenter in 1992 (Payne & Ross, 2005). Similar to the false memory test, working memory test has also being used for years and having replicable and significant results showing that working memory is differ from one individual to another too. In this case, The Go Cognitive website has been selected for the working memory test.

Go Cognitive is a website that has been used as educational tools for cognitive neurosciences which are being funded and maintained by Association for Psychological Science (aps), University of Idaho, National Science Foundation (NSF) and Idaho State Board of Education, USA. With the development background and trusted organisations behind the instruments chosen, it is strongly believed that the instruments to be used in the test are highly reliable.

3.4.3 Instrument for False Memory Test

This is another pre-programmed test application to experiment on false memory. The test is known as DRM paradigm. In the test, participants will be presented a list of words to recall. After each block of words, participants will be asked to recognize the words in the core of a list of distractors. There are two types of distractors: regular distractors and a distractor that is related semantically, linguistically, or conceptually to all of the words on the list presented (non-presented critical lure). The experiment may be able to lead the researcher to find out which type of distractor participants recall the most.

The DRM paradigm to be used is displayed such as below:

Block #	Displayed Words	Sample Critical Lures	Sample Distractor
1	Sandpaper, sand, boards, ready, tough, jagged, bumpy, riders, uneven, smooth, ground, road, coarse, gravel, rugged	Rough	Sofa, honey, seat, ski, cake summit, sand, sleep
2	Recliner, sitting, table, desk, seat, couch, stool, cushion, sit, bench, swivel, wood, rocking, sofa, legs	Chair	Pin, ski, drowsy, grass, road, needle, chocolate
3	Soda, pie, heart, chocolate, candy, nice, sour, good, honey, tart, taste, cake, sugar, bitter, tooth	Sweet	Sewing, sleep, doze, house, point, sandpaper, range
4	Bed, peace, wake, rest, snore, slumber, snooze, nap, awake, tired, drowsy, blanket, doze, dream, yawn	Sleep	Molehill, telephone, thread, rocking, tough, ready,

			haystack
5	Haystack, eye, thorn, thread, hurt, thimble, sloth, point, sharp, knitting, pin, injection, prick, syringe	Needle, cloth, sewing	Wood, ground, swivel, sandpaper, awake, plain, climb
6	Steep, molehill, top, plain, ski, valley, glacier, range, bike, goat, peak, hill, climb, summit, climber	Play, point, mountain	Bench, boards, cake, table, honey

Table 3.1: The DRM paradigm for the study

Variables such as type of memory task (words or pictures), length of recognition list, number of trial blocks, duration of each item, time for recognition, number of items shown during recognition, number of items allowed to pick during recognition, font size, duration of fixation target before block, relative position of the word and delay between responses can be set accordingly.

It has been suggested that:

1. Student with better visual-spatial intelligence tends to hit lower percentage of false memory formation when encounter with picture task for false memory test;
2. Student with better verbal-linguistic intelligence tends to hit lower percentage of false memory formation when encounter with word task for false memory test.

Thus, in the experiment, all the participants will only be sitting for the test once for words task and once for pictures task with all the setting programmed at default value of:

For words task:

Length of recognition list	15
Number of trial blocks	6
Duration of each item	3 seconds
Time for recognition	30 seconds
Number of items shown during recognition	16 words
Number of items allowed to pick during recognition	8 words
Font size	24 point
Duration of fixation target before block	1 second
Relative position of the word	X: 0.5 Y: 0.85
Delay between responses	0 second

Table 3.2: The setting for false memory test (words task)

For pictorial (pictures) task:

Length of recognition list	11
Number of trial blocks	6
Duration of each item	3 seconds
Time for recognition	30 seconds
Number of items shown during recognition	16
Number of items allowed to pick during recognition	8
Duration of fixation target before block	1 second
Delay between responses	0 second

Table 3.3: The setting for false memory test (pictures task)

After the test, results will be generated such as below (example):

Type of selected items	Percentage of reports
ProportWordRecog	0.83
ProportDistractRecog	0.17
WordTaskProportSpecialDistractRecog	0.67

Table 3.4: The example result for false memory test

The balance after deduction of the "percentage of reports" in "ProportWordRecog" will be the percentage for false memory formation of the participant.

The test can be reached online at:

http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition/falsememory_instru ctions.html

3.4.3.1 Validity and Reliability of False Memory Test

As justification for its reliability and validity, false memory test was first invented by Deese in 1959 and later undergone extension by Roediger and McDermott in 1995 (Vanhorn, 2011) which is then being named as the Deese-Roediger-McDermott (DRM) paradigm. It has then been used for years with replicable and significant results showing the existence of false memory is differ from one individual to another. To ensure that the online false memory testing instrument uses for this research is reliable, the site http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition/falsememory_instru ctions.html was chosen.

This is due to the reason that the site has been developed and prepared by the Hanover College Psychology Department, which based in Hanover, Indiana,

USA for academic research purpose. The site has always been monitored from time to time to ensure its functionality.

This site has also been chosen for the fact that it is an innovated version of false memory test that is having option for either word task or picture task, unlike other such as CogLab which only having the word task false memory test

3.5 Procedures for Data Collection & Analysis

This section briefs on procedures for data collection and analysis. However, the results and discussion will only be presented in Chapter 4 and Chapter 5.

3.5.1 Pre-testing

Data will be collected from five random subjects of university senior undergraduates living in West Malaysia. The participants or subjects will be going through the sampling procedures mentioned. The results of the participants will be analysed using the IBM SPSS Statistics software. The analysis for pre-testing will ensure the validity of the planned research, that is to check if the tests suggested in Chapter 1 are suitable or not. Any necessary changes will be made to ensure the study is functional. Any mistake made by pre-testing participants will also be recorded as a precaution step to give advice to actual test participants or to make adjustment for the real test.

3.5.2 Real/Actual Test

Data will be collected from 65 students of University Malaysia Sarawak (UNIMAS). Similar to the pre-testing, participants are selected based on the ruled criteria, which is, the participant must be a undergraduate and is at least in one's

second semester. The results of the participants will too be analysed using the IBM SPSS statistics software.

The issues to be test in this experiment included:

1. The effect of CGPA on false memory.
2. The effect of multiple intelligences on false memory.
3. The effect of working memory on false memory.

3.6   Limitations/Delimitations

There are a few limitations in the experiment.

1. For false memory test, reselection is not allowed. This may be a trouble for the participant who mistakenly slipped and wrongly select in the recognition list. However, this human error can be reduced by briefing the participants.
2. Health conditions such as lack of rest and illness can be a threat or issue affecting the attention performance and thus memory. However, this can be resolved by careful selection and understanding on participants.
3. Repeated testing for the similar experiment may not be having consistent and accurate result.
4. Due to the time constrain in conducting the research, the quantity targeted and allocated for the research may not be sufficiently enough to portray a general conclusion that is applicable all over the world, and may be subject or limited to specific category, population or even location only. The experiment also has mainly studied on conjoint recognition only, which is the false memory in short-term memory due to time factor.

3.7   Chapter Summary

In conclusion, the research is considered reliable and valid due to the facts that all the instruments used have widely being recognised. The details of procedures have also being explained clearly in this section. Meanwhile, the experiment will be conducted following go green concept whereby paper-use is being reduced as much as possible, replaced by digital based technology such as by utilising the use of laptop and internet. The next chapter will be deliberating on findings and discussion.

CHAPTER 4

FINDINGS

4.0   Overview

This chapter discusses the outcomes of the research. Results that have been tabulated will be shown and analysis will be made.

4.1 Revision on Research Objectives/Questions

This study was originally targeted to test on the relationship between the factors and false memory formation. There are a total of three components tested inside the false memory test: word recognition, distractor and special distractor (critical lure). However, it is soon being extended to include the relationship between those factors considered to see if they affect one another, of which may be used to explain any relationship existing.

Below briefly tabulated the latest and much detailed research objectives:

In this research, it is to find out:
A. CGPA
1. Relationship between CGPA and ability of rejecting false memory formation (word recognition)
2. Relationship between working memory capacity (WMC) and CGPA
3. Relationship between CGPA and false memory formation due to special distractor
4. Relationship between CGPA and false memory formation due to distractor
5. Relationship between CGPA and ability of face recognition
6. Relationship between CGPA and ability of face allocation
B. WMC
1. Relationship between working memory capacity (WMC) and ability of rejecting false memory formation (word recognition)
2. Relationship between logical-mathematical intelligence and working memory capacity (WMC)
3. Relationship between visual-spatial intelligence and working memory capacity (WMC)
4. Relationship between working memory capacity (WMC) and false memory formation due to special distractor
5. Relationship between working memory capacity (WMC) and false memory formation due to distractor

C. **Multiple Intelligence**
• ***Verbal-Linguistic Intelligence*** 1. Relationship between verbal-linguistic intelligence and ability of rejecting false memory formation (word recognition) 2. Relationship between verbal-linguistic intelligence and false memory formation due to special distractor 3. Relationship between verbal-linguistic intelligence and false memory formation due to distractor   • ***Visual-Spatial Intelligence*** 1. Relationship between visual-spatial intelligence and ability of face recognition 2. Relationship between visual-spatial intelligence and facial allocation   ** ***Logical-mathematical intelligence*** was being included in the research objectives to investigate its relationship with working memory capacity (WMC) for digit span as mentioned in the section above.

Table 4.1: Summary on Objectives

It is to take note that another objective was being added to this research report after the generation of results using IBM SPSS Statistics software revealed that all the three components in false memory test showed a positive result in affecting the CGPA which is the "prediction of CGPA using various components of false memory formation".

This extra objective has been proposed as a way to investigate which component is best predicting students' CGPA among all the three related components.

Similarly, while it has been found out that both CGPA and WMC possess significant relationships with false memory formation due to distractor, thus another objective "prediction of false memory formation due to distractor using CGPA and WMC" is added to measure which is the best predictor.

All the results for the 18 objectives above will be showed and discussed in the upcoming sections.

4.2 Findings

In the pre-test, 5 participants who are also some undergraduates from local universities have been used to test if the planned tests (instruments) are suitable to be used in this research. This is to check out on time factor as well as any special circumstance that may be found out from the tests. Any unnecessary tests have been eliminated to avoid too much time needed for the conduction of experiment.

From observation, it was found out that one of the initially selected tests – the false memory test using pictures from the selected oversea university's website was not ideal enough to test after one's memory due to issue such as too easy and simplified pictures that present in the list of choice which the existence of critical lures is considered nil. Every pre-test participant has scored one out of one in the picture recognition score and zero out of one in both the distractor and special distractor scores.

Thus, another back up test – face memory test from the BBC website has been implemented to replace the test mentioned as another test for visual memory. This website was chosen due to the reason that it is a famous website host by the BBC Company which always choose and select the content carefully; and also showed only contents that have been justified and confirmed valid. It is widely used by the society. As a support to this, its users include lecturers from different universities are making the tests prepared by the website as assignments to be done by the students. For a more solid and familiar example, Dr Chen Chwee Jen has used the test from this website as an assignment to be completed by the students in UNIMAS for the course KMF 1014 Introduction to Cognitive Science. This has showed the reliability and faith of professionals in the website. This test can be reached at: http://www.bbc.co.uk/science/humanbody/sleep/tmt/

4.2.1 General Summary on Findings

Generally, from the analysis, it has been found out that working memory capacity (WMC) and multiple intelligences did not really contributed or related to false memory formation. However, the average frequency of false memory formation does significantly affecting the CGPA. There are a total of three components tested in the false memory test. These components include: ability of rejecting false memory formation (word recognition), false memory formation due to special distractor and false memory formation due to distractor.

All the three components tested in the false memory test, or namely DRM paradigm, have showed moderate to low relationships with CGPA. Meanwhile, when all the three components were being put on regression analysis, it has been found out that the component "special distractor" is best to make prediction on CGPA.

On the other hand, although working memory capacity (WMC) may not significantly related to all the components inside the false memory test, it showed a negative and very weak to low relationship with the component "distractor" in the false memory test.

4.2.2 Detailed Findings Explanation

Investigation Items	Correlation Test Used	Null Hypothesis	p-value	Correlation Coefficient	Relationship
A. CGPA					
1. Relationship between CGPA and ability of rejecting false memory formation (word recognition)	Spearman's Rank-Order Correlation Analysis	Rejected	$p < 0.05$ (0.005)	0.341	Positive and moderate to low

2.	Relationship between working memory capacity (WMC) and CGPA	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.422)	0.101	Positive and too low to be meaningful
3.	Relationship between CGPA and false memory formation due to special distractor	Spearman's Rank-Order Correlation Analysis	Rejected	p<0.05 (0.014)	0.305	Positive and moderate to low relationship
4.	Relationship between CGPA and false memory formation due to distractor	Spearman's Rank-Order Correlation Analysis	Rejected	p<0.05 (0.007)	-0.331	Negative and moderate to low relationship
5.	Relationship between CGPA and ability of face recognition	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.281)	0.136	Positive and too low to be meaningful
6.	Relationship between CGPA and ability of face allocation	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.211)	0.157	Positive and too low to be meaningful
B. WMC						
1.	Relationship between working memory capacity (WMC) and ability of rejecting false memory formation (word recognition)	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.251)	0.144	Positive and too low to be meaningful

No.		Method	Decision	p-value	Coefficient	Interpretation
2.	Relationship between logical-mathematical intelligence and working memory capacity (WMC)	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.991)	0.002	Positive and too low to be meaningful
3.	Relationship between visual spatial intelligence and working memory capacity (WMC)	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.965)	0.006	Positive and too low to be meaningful
4.	Relationship between working memory capacity (WMC) and false memory formation due to special distractor	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.733)	-0.043	Negative and too low to be meaningful
5.	Relationship between working memory capacity (WMC) and false memory formation due to distractor	Spearman's Rank-Order Correlation Analysis	Rejected	p<0.05 (0.025)	-0.278	Negative and weak to low
C. Multiple Intelligence						
• *Verbal-Linguistic Intelligence* 1. Relationship between verbal-linguistic intelligence and ability of rejecting false memory formation (word recognition)		Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.705)	0.048	Positive and too low to be meaningful

2. Relationship between verbal-linguistic intelligence and false memory formation due to special distractor	Pearson Product-Moment Correlation Analysis	Not Rejected	p>0.05 (0.450)	0.095	Positive and too low to be meaningful
3. Relationship between verbal-linguistic intelligence and false memory formation due to distractor	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.753)	0.04	Positive and too low to be meaningful
• *Visual-Spatial Intelligence* 1. Relationship between visual-spatial intelligence and ability of face recognition	Spearman's Rank-Order Correlation Analysis	Not Rejected	p>0.05 (0.237)	-0.149	Negative and too low to be meaningful
2. Relationship between visual-spatial intelligence and facial allocation	Pearson Product-Moment Correlation Analysis	Not Rejected	p>0.05 (0.468)	0.092	Positive and too low to be meaningful

Table 4.2: Summary on Correlation Test Result

From the above, we can see that out of the 16 relationships investigated, only two (relationship between verbal-linguistic intelligence and false memory formation due to special distractor; and relationship between visual-spatial intelligence and facial allocation) are using Pearson Product-Moment Correlation Analysis, while the rest are using Spearman's Rank-Order Correlation Analysis. This is because Pearson Product-Moment Correlation Analysis will only be used if all the values of skewness and kurtosis inside the variables tested are between -1 to 1. Any skewness and kurtosis value outside the range indicates that the data is

non-linear and thus a Spearman's Rank-Order Correlation Analysis shall be used instead.

Meanwhile, of all the 16 relationships investigated, only four of them have rejected their null hypotheses. These included: i) Relationship between CGPA and ability of rejecting false memory formation (word recognition) with p-value<0.05 and Spearman's Correlation Coefficient of 0.341 indicating a significant positive and moderate to low relationship; ii) Relationship between CGPA and false memory formation due to special distractor with p-value<0.05 and Spearman's Correlation Coefficient of 0.305 indicating a significant positive and moderate to low relationship; iii) Relationship between CGPA and false memory formation due to distractor with p-value<0.05 and Spearman's Correlation Coefficient of -0.331 indicating a significant negative and moderate to low relationship; and iv) Relationship between working memory capacity (WMC) and false memory formation due to distractor with p-value<0.05 and Spearman's Correlation Coefficient of -0.278 indicating a significant negative and weak to low relationship. On the other hand, the others are not having their null hypotheses rejected by having p-value>0.05.

Meanwhile, since that all the three components tested in the false memory test, were discovered to have moderate to low relationship with CGPA, the components are tested using multiple linear regression analysis to see which is best predicting one's CGPA. Or in another way of saying, it can see if CGPA is more likely to predict any components in false memory through their relationship.

Investigation Items	Regression Test Used	Null Hypothesis	Best Predictor (s)	F	Value	R^2
Prediction of CGPA using various components of false memory formation	Multiple Linear Regression Analysis	Rejected	False memory formation due to special distractor	4.599	t = 2.145, p < 0.05 (0.036)	0.068

Table 4.3: Summary on Regression Analysis Result 1

From the table above, it is noted that a multiple linear regression analysis was used to test on prediction of CGPA through the components in false memory test. The null hypothesis was rejected (F (1, 63) = 4.599, p < 0.05 (0.036)). In the meantime, it is found out that false memory formation due to special distractor (t = 2.145, p < 0.05) can predict the students' CGPA based on the following equation:

Students' CGPA =

0.403 (false memory formation due to special distractor) + 3.13

The independent variable (false memory formation due to special distractor) has contributed towards 6.8% (R^2 = 0.068) of the students' CGPA.

Following that, another multiple linear regression analysis is being performed to test after the best predictors for false memory formation due to distractor between CGPA and WMC.

Investigation Items	Regression Test Used	Null Hypothesis	Best Predictor (s)	F	Value	R^2
Prediction of false memory formation due to distractor using CGPA and WMC	Multiple Linear Regression Analysis	Rejected	False memory formation due to distractor	4.043	t = - 2.011, p < 0.05 (0.049)	0.060

Table 4.4: Summary on Regression Analysis Result 2

From the table above, it is noted that a multiple linear regression analysis was used to test on prediction of false memory formation using CGPA and WMC. The null hypothesis was rejected (F (1, 63) = 4.043, p < 0.05 (0.049)). In the meantime, it is found out that WMC (t = -2.011, p < 0.05) can predict the students' false memory formation due to distractor based on the following equation:

False Memory Formation due to Distractor =

-0.017 (WMC) + 0.217

The independent variable (WMC) has contributed towards 6.0% (R^2 = 0.060) of the students' false memory formation due to distractor.

4.3   Results

This section will tabulate the related conclusion accordingly.

Investigation Items	Conclusion from Results
A. CGPA	
1. Relationship between CGPA and ability of rejecting false memory formation (word recognition)	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value < 0.05 (0.005) indicated that the null hypothesis was rejected with the correlation coefficient r = 0.341 showed that there was a positive and moderate to low relationship between students' CGPA and the ability of rejecting false memory formation (word recognition). Thus, as shown in the scatter diagram (refer figure 4.1 in Appendix A), students' CGPA has significant relationship with the ability of rejecting false memory formation (word recognition).
2. Relationship between working memory capacity (WMC) and CGPA	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.422) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.101 showed that there was a positive and too low to be meaningful relationship between students' working memory capacity (WMC) and CGPA. Thus, as shown in the scatter diagram (refer figure 4.2 in Appendix A), students' working memory capacity (WMC) has no significant relationship with CGPA.
3. Relationship between CGPA and false memory formation due to special distractor	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value < 0.05 (0.014) indicated that the null hypothesis was rejected with the correlation coefficient r = 0.305 showed that there was a positive and moderate to low relationship between students' CGPA and false memory formation due to special distractor. Thus, as shown in the scatter diagram (refer figure 4.3 in Appendix A), students' CGPA has significant relationship with false memory formation due to special distractor.
4. Relationship between CGPA and false memory formation due to distractor	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value < 0.05 (0.007) indicated that the null hypothesis was rejected with the correlation coefficient r = -0.331 showed that there was a negative and moderate to low relationship

	between students' CGPA and false memory formation due to distractor. Thus, as shown in the scatter diagram (refer figure 4.4 in Appendix A), students' CGPA has significant relationship with false memory formation due to distractor.
5. Relationship between CGPA and ability of face recognition	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.281) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.136 showed that there was a positive and too low to be meaningful relationship between students' CGPA and ability of face recognition. Thus, as shown in the scatter diagram (refer figure 4.5 in Appendix A), students' CGPA has no significant relationship with ability of face recognition.
6. Relationship between CGPA and ability of face allocation	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.211) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.157 showed that there was a positive and too low to be meaningful relationship between students' CGPA and ability of face allocation. Thus, as shown in the scatter diagram (refer figure 4.6 in Appendix A), students' CGPA has no significant relationship with ability of face allocation.
B. WMC	
1. Relationship between working memory capacity (WMC) and ability of rejecting false memory formation (word recognition)	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.251) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.144 showed that there was a positive and too low to be meaningful relationship between students' working memory capacity (WMC) and the ability of rejecting false memory formation (word recognition). Thus, as shown in the scatter diagram (refer figure 4.7 in Appendix A), students' working memory capacity (WMC) has no significant relationship with the ability of rejecting false memory formation (word recognition).
2. Relationship between logical-mathematical intelligence and working memory capacity (WMC)	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.991) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.002 showed that there was a positive and too low to be meaningful relationship between students' logical-

	mathematical intelligence score and working memory capacity (WMC). Thus, as shown in the scatter diagram (refer figure 4.8 in Appendix A), students' logical-mathematical intelligence score has no significant with working memory capacity (WMC).
3. Relationship between visual spatial intelligence and working memory capacity (WMC)	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.965) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.006 showed that there was a positive and too low to be meaningful relationship between students' visual-spatial intelligence score and working memory capacity (WMC). Thus, as shown in the scatter diagram (refer figure 4.9 in Appendix A), students' visual-spatial intelligence score has no significant with working memory capacity (WMC).
4. Relationship between working memory capacity (WMC) and false memory formation due to special distractor	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.733) indicated that the null hypothesis was not rejected with the correlation coefficient r = -0.043 showed that there was a negative and too low to be meaningful relationship between students' working memory capacity (WMC) and the false memory formation due to special distractor. Thus, as shown in the scatter diagram (refer figure 4.10 in Appendix A), students' working memory capacity (WMC) has no significant relationship with false memory formation due to special distractor.
5. Relationship between working memory capacity (WMC) and false memory formation due to distractor	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value < 0.05 (0.025) indicated that the null hypothesis was rejected with the correlation coefficient r = -0.278 showed that there was a negative and weak to low relationship between students' working memory capacity (WMC) and the false memory formation due to distractor. Thus, as shown in the scatter diagram (refer figure 4.11 in Appendix A), students' working memory capacity (WMC) has significant relationship with false memory formation due to distractor.
C. Multiple Intelligence	

• *Verbal-Linguistic Intelligence* 1. Relationship between verbal-linguistic intelligence and ability of rejecting false memory formation (word recognition)	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.705) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.048 showed that there was a positive and too low to be meaningful relationship between students' verbal-linguistic intelligence score and the ability of rejecting false memory formation (word recognition). Thus, as shown in the scatter diagram (refer figure 4.12 in Appendix A), students' verbal-linguistic intelligence score has no significant relationship with the ability of rejecting false memory formation (word recognition).
2. Relationship between verbal-linguistic intelligence and false memory formation due to special distractor	The Pearson Product-Moment Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.450) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.095 showed that there was a positive and too low to be meaningful relationship between students' verbal-linguistic intelligence score and false memory formation due to special distractor. Thus, as shown in the scatter diagram (refer figure 4.13 in Appendix A), students' verbal-linguistic intelligence score has no significant relationship with false memory formation due to special distractor.
3. Relationship between verbal-linguistic intelligence and false memory formation due to distractor	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.753) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.04 showed that there was a positive and too low to be meaningful relationship between students' verbal-linguistic intelligence score and false memory formation due to distractor. Thus, as shown in the scatter diagram (refer figure 4.14 in Appendix A), students' verbal-linguistic intelligence score has no significant relationship with false memory formation due to distractor.
• *Visual-Spatial Intelligence* 1. Relationship between visual-spatial intelligence and ability of face recognition	The Spearman's Rank-Order Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.237) indicated that the null hypothesis was not rejected with the correlation coefficient r = -0.149 showed that there was a negative and too low to be meaningful relationship between students' visual-spatial intelligence score and the ability of face recognition. Thus, as shown in the scatter diagram

	(refer figure 4.15 in Appendix A), students' visual-spatial intelligence score has no significant relationship with the ability of face recognition.
2. Relationship between visual-spatial intelligence and facial allocation	The Pearson Product-Moment Correlation Analysis was used to test for the stated hypotheses. The results with a p-value > 0.05 (0.468) indicated that the null hypothesis was not rejected with the correlation coefficient r = 0.092 showed that there was a positive and too low to be meaningful relationship between students' visual-spatial intelligence score and the ability of face allocation. Thus, as shown in the scatter diagram (refer figure 4.16 in Appendix A), students' visual-spatial intelligence score has no significant relationship with the ability of face allocation.
D. Prediction of CGPA using various components of false memory formation	A multiple linear regression analysis was used to test for the stated hypotheses. The null hypothesis was rejected (F (1, 63) = 4.599, p < 0.05 (0.036)). False memory formation due to special distractor (t = 2.145, p < 0.05 (0.036)) can predict the students' CGPA based on the following equation: Students' CGPA= 0.403 (false memory formation due to special distractor) + 3.13 The independent variable (false memory formation due to special distractor) contributed towards 6.8% ($R^2 = 0.068$) of the students' CGPA.
E. Prediction of false memory formation due to distractor using CGPA and WMC	A multiple linear regression analysis was used to test for the stated hypotheses. The null hypothesis was rejected (F (1, 63) = 4.043, p < 0.05 (0.049)). WMC (t = -2.011, p < 0.05 (0.049)) can predict the students' false memory formation due to distractor based on the following equation: False Memory Formation due to Distractor = -0.017 (WMC) + 0.217 The independent variable (WMC) contributed towards 6.0% ($R^2 = 0.060$) of the students' false memory formation due to distractor.

Table 4.5: Tabulation of Conclusion

4.4 Discussion

Basically, the research in this area is still new. Most people have been looking at the potential factors without taking much careful view on the sub-components in their research. However, in this study, the related sub-components of every suggested factors and variables involved have been seriously taken onto consideration whether with or without literature support from previous studies.

4.4.1 CGPA and False Memory

While previous studies mostly concentrate in findings the relationship between CGPA and ability to suppress false memory formation, in this research, the result has too showing a match with previously cited literature that CGPA is having a close relationship with ability to suppress false memory formation, however with more precisely, CGPA is having significant relationships with all the components in the false memory test. Meanwhile, as of that mentioned above, the component "special distractor" is best to make prediction on CGPA, this may be due to the fact that human remember things through representation of concepts - as the main pinned description on the Spreading Activation Theory in the Semantic Network Theories (Balota & Duchek, 1989) and gist traces in FTT. While one is given a multiple choice question that has very close definition between each choice, the person might be experiencing retroactive interference and when confusion comes to act, he lost his source of activation and monitoring process is being weaken such that mentioned by the Activation Monitoring Theory, causing the formation of false memory.

To apply this findings with our example experience: This may suggest the answer to why students easily chosen the wrong answer in objective questions that have answers too closely related whether in the way of expressing and meanings, or even the naming of the terms, and is happening more often in students who gained higher CGPA in their academic performance. This could be caused by the way the students catch up with knowledge, such that high CGPA students tend to

understand the concepts while low CGPA students tend to memorize words-by-words.

4.4.2   Working Memory Capacity (WMC) and False Memory

On the other hand, while research works on the relationship between working memory capacity (WMC) and false memory formation are achieving consistent results indicating that low WMC span individuals tend to possess lower ability to reject false recall and vice versa whether with or without warnings on critical lures, it is not getting a parallel similarity in this research. However, although working memory capacity (WMC) may not reveal a result that significantly related to all the components inside the false memory test, it showed a negative and very weak to low relationship with the component "distractor" in the false memory test.

Again, to apply this findings with our example experience: This may suggest the underlying reason why lectures may sometimes get weird and unrelated answers from students, particularly those with lower WMC in the examination, especially during the final examination where students may have to sit up to three examinations per day. Their working memory may have retrieved the wrong information from the long term memory, and thus the students wrote some confusing answers in the examination. This may be happen due to the lack of understanding in the knowledge along with some imagined explanations or incorrect linking of knowledge across chapters even across subjects that eventually causing confusion between true and false memories as suggested by the Visual Imagery Hypothesis as well as insufficient time for the consolidation of knowledge learn. Likewise, as suggested by Activation Monitoring Theory, when one's attention control and monitoring process is disturbed, one may susceptible to false memory. Meanwhile, terms used in the question paper which can be some terms giving different meaning across different field might contribute to a phenomenon known as retrieval cue may mislead the student understanding to he question. For example, the term "CGPA" although may mostly refer to

cumulative grade point average, however, in the area of computer vision, it refers to Continuous Generalized Procrustes Analysis.

Besides, WMC also showed to be a better predictor to the false memory formation due to distractor than CGPA. This may be because CGPA achievement can be influenced by outside individual factors such as the lecturer who is giving the marks as well as personal strength factors, for instance, the participant may be strong in certain subjects but weak in others, thus affecting the CGPA.

4.4.3   Multiple Intelligences and False Memory

Meanwhile, the tests on relationship between the selected components in multiple intelligences and false memory formation are showing no correlation between each other for every sub-component. The suggestions that student possessing higher verbal-linguistic intelligence scores better in the word task false memory test and student possessing higher visual-spatial intelligence scores better in the visual test are not being accepted in the test results. Likewise, previous studies over this area did not attain a consistent result too. Such as that being mentioned in literature review, very little studies have been conducted over this area and most of the time, the results between the studies are contradicting.

4.4.4   Extended Studies

This part discusses on the extended studies over the relationships between the factors suggested with the formation of false memory. As mentioned above, the sub-components in the variables have been taken into account separately for a detailed investigation. However, while most people are focus only on the effect of suggested factors to the formation of false memory and not the possible relationships between factors contributed to false memory formation, only very little literature review is available for reference to the discussion in below.

4.4.4.1 CGPA and Working Memory Capacity (WMC)

In a research by Bell and Cooke (n.d.) has showed that individuals with higher CGPA tend to have better working memory capacity. However, the result from this research has stated that there is no significant relationship between CGPA and WMC. More research under this category shall be conducted to find out the actual relationship status between these two variables.

4.4.4.2 CGPA and Face Memory Test

At the moment there is still no prior research surveying on the relationship between the two variables: CGPA and face memory test. However, in this research, it was found out that there are no significant relationships between CGPA and all the sub-components of face memory test which include face recognition and facial allocation. More research under this category shall be conducted to find out a consistent and accurate relationship status between these two variables.

On the other hand, in the research by Zhu (2010), it was found out that there is a significant and negatively correlated relationship between false memory formation and face recognition. This relationship however is not being considered in this research because it was not part of the aim in this research, but to implement the face memory test as a substitution of picture task false memory test to be another test to investigate on participant's visual memory.

4.4.4.3 Working Memory Capacity (WMC) and Multiple Intelligences

At the moment there is still no prior research surveying on the relationship between WMC and multiple intelligences. However, in this research, it was found out that there are no significant relationships between WMC in digit span and logical-mathematical intelligence. Again, such of that mentioned above, more

research under this category shall be conducted to find out a consistent and accurate relationship status between these two variables

4.4.4.4 Multiple Intelligences and Face Memory Test

At the moment there is still no prior research surveying on the relationship between the two variables: multiple intelligences and face memory test. However, in this research, it was found out that there are no significant relationships between visual-spatial intelligence and all the sub-components of face memory test which include face recognition and facial allocation. More research under this category shall be conducted to find out a consistent and accurate relationship status between these two variables.

4.4.5 Suggestions

The reasons behind why the result of current study is not having a full matching with the outcomes of other studies may include:

a. Different nation different context.
b. Malaysia students are not so proactive in participating in research, causing the problem of hard to find self-volunteering participants randomly, and making the test result to be possibly biased towards specific group of people that related with researcher only.
c. Some of the words in the DRM list might beyond the understandings of the participants and have low distinctiveness between words, such as that mentioned in the literature review, the test modality can affect one's false recall (Silbermann, 2007). This may suggest why the relationships found in the current test are at most achieved the level of moderate to low only instead of strong relationship that occurred in most previous studies.

d. Through observation, technical error of slow understandings and recall on words during the selection stage in DRM occurred in small portion of participants, causing them not able to fulfil the target number of selection that one shall make. Thus, the result may get slightly affected. To solve the problem in the next research, time increment for the selection stage shall be considered, but at reasonable interval to avoid impatience and frustration on waiting by the participants who possess fast recalling.

e. It is found that the WMC test may be a bit irritating due to its prolong consumption of time in getting the average digit span of participant, inducing the participant have to force oneself to continue and completing the test reluctantly.

f. All the multiple intelligence tests available in the form of questionnaire only. This may not be able to test after one's intelligence precisely as some persons are more likely a bodily kinaesthetic person whereby questions in auditory or visual forms may not suit them, and they may lose interest or patients in answering the questions.

As for information here, some educators and researchers think and suggested that multiple intelligences may indicate the learning styles or learning preferences of an individual. However, according to Howard Gardner (2013), multiple intelligences are not learning styles. Intelligences may be improved after regular practice, for instance, ones able to speak a foreign language well after sometimes practising it. Meanwhile, a learning style refers to how an individual approaches the range of materials to learn. For this saying, multiple intelligences are different from learning styles (Strauss, 2013).

There are three types of learners, namely visual learners, auditory learners and tactile (bodily kinaesthetic) learners (Katherine, 2012). Visual learners acquired knowledge and skills best through visual objects; auditory learners absorb information best through hearing and speaking; while bodily kinaesthetic learners pick up understanding best through trial and error, demonstration and

experience (Bepko Learning Center, 2014), alternatively to be known as hands-on approach (Farewell, 2012).

g. Health condition may be a factor determining the result of the test. While illness such as cough and influenza are easily being detected, some invisible symptoms for diseases can hardly be detected. On the other hand, sleeping duration can be a factor affecting the functioning of the memory too. It has been said that prolonged sleep deprivation will increase the chance of forming false memory (Smith, 2008).

h. Environment issues such as temperature, noisy, uncomfortable seats, and light contrast of the room may make the participants feeling disturbed and thus interferes with the result. As acknowledged in the literature review, distraction may affect ones attentional control which is considered as one of the primary functions for WMC.

i. Mood such as frustrated and upset; and high stress level due to assignments or personal issues such as conflict relationship may cause the participants unable to concentrate or focus while sitting for the experimental tests.

Stress may interfere with one's working memory capacity while the individual is trying to retrieve the information from the short-term or long-term memories (Centre of Studies on Human Stress, 2014). On the other hand, in the research paper by Justin Storbeck (2013), the researcher suggested that negative emotional cues given under negative affect promotes item-specific processing which is capable in reducing false memories (Storbeck, 2013). This can otherwise be inferred that different compatibility between moods and the categories of word presented or entirely by the mood itself is capable of influencing the progression of the test, and thus the results may got affected.

4.5   Chapter Summary

This chapter has revised the research objectives for current study, explaining on the findings, displaying the important data on the results, discussing the findings by relating them back to the literature review and proposing opinions on the differences of outcome compare to other research studies based on interpretations.

The next chapter will be summarising the research and stating on implications of findings and future works.

CHAPTER 5

SUMMARY

5.0   Overview

This chapter summarises the important issues and overall components involved in the research. Suggestions will also being given for improvement of similar research that is to be carried out in the future.

5.1   Summary of Study

This research was first motivated by the knowledge discovered about False Memory Syndrome. And after a number of readings, it was found out that Malaysians' awareness on the syndrome stated is relatively low. Thus, a research to investigate the factors contributing to false memory in short-term memory is then being proposed in order to determine the possible factors to the formation of false memory before works of raising awareness is to be executed. The research proposed is first to be started from the undergraduate population in a small scale. Factors assumed to be capable of affecting false memory formation in undergraduates include: CGPA, multiple intelligences and working memory capacity (WMC).

Literature review has shown that there are a couple dozens of factors and theories have been proposed on this happening of false memory syndrome although research in this area is still relatively low. However, not every idea of factors proposed showed influence on false memory formation. The most widely recognized factor is WMC.

In the current study, five participants were taken to examine on the application of selected tests in the proposal stage. Any precaution and necessary changes have been recorded for a launching of efficient actual test. A total of 65 participants have been used for the actual test. These participants were to sit on all the essential tests in order to generate a result finding for this research.

In pre-experiment stage, it was planned to study the research with only 5 hypotheses. However, after the experimental and data analysis tasks have been conducted, it was found out that the research can be searching up till 18 hypotheses. It was however, significant relationships were only appeared in between word recognition, false memory formation due to distractor and false memory formation due to special distractor with CGPA. Meanwhile among these three components, false memory formation due to special distractor is best predicting one's CGPA. On the other side, WMC has showed a significant relationship with the false memory formation due to distractor; and while being

compared with CGPA, WMC was a better variable predicting one's average score of false memory formation due to distractor.

The outcomes of this research are not totally consistent with the outcomes of other similar researches. This may be due to human body errors as limitations of the test; or the shortness of the tests selected for examining the factors.

Yet, this research has shown a hope of improving ones memory in recalling and may be able to figure out better ways of suppressing the false recognition if further experiments, interpretations and linking of knowledge on human brain processes are being conducted.

The implications of the findings and future works will be discussed below.

5.2   Implications of Findings

The findings in this research have indicated that there is a relationship between: a) CGPA and all the three components inside false memory test; b) WMC and distractor (one of the components inside false memory test). Being informed with the knowledge learned from the findings, steps can be taken to improve both CGPA and WMC. For example,

- Better learning and teaching approach that suit the individuals according to their learning style starting from both informal education at home and formal education pre-school.
- Special training on memory learning and retrieval; and interpretation of knowledge.
- Good management of time for activities such as outdoor sports, indoor exercises, social interaction, sleep, and study activities.
- Consuming healthy and nutrition food that is good for brain, memory and the body.
- Good management of mental health and mood to promote one's acceptance towards unwanted facts by well handling of defense

mechanisms that exist naturally in individuals. For example, intellectualization might be able to avoid denial and thus reduce the possible happenings of hallucination, illusion or fake imagination.

Theoretically, if following the research findings, once individuals CGPA and WMC is being improved, the involved young generations may tend to show a lower rate in false memory formation, hence directly forming a society with better justice system as their ability to manage with the memory have turned them to be more ideal witnesses if there are happenings of on-sight criminal cases. Nevertheless, school teachers or teaching professionals can also use this findings and knowledge to set a better syllabus for education and related examinations.

5.3   Future Research Direction

Before stating possible directions that can be taken for future works, there are some advices to be given to the forthcoming research study:

- Recruiting more participants to generalize findings that applicable across the population.
- Offer compensation to participants in order to attract more people to sit for the test willingly
- Book a whole laboratory to conduct the experiment for peaceful and quiet environment.
- Shorten the overall period consumption needed per experiment setting.

Following that, there are a few directions which can be considered to be taken in the future research.

- Apply a few versions of the DRM paradigm with different level of complexity - easy to difficult to see if there is any improvement or declination in the relationships

- Consider health condition of participants. For instance, checking the differences in ability to suppress false recall across different group of diseases

- Consider different types of test. For example, there are three common options of WMC test. The one used in current study is visual digits (digit span) only. Thus, the other two types of WMC test: Shapes & Simple Math may be applied.

- Consider the difference between ages, sleep duration, gender or even between ethnic.
  - This idea is inspired by Paula Carneiro and Angel Fernandez whom revealed their experimental result that older children were more capable of rejecting associative false memories than younger children with the help of warnings and by slowing the presentation rate (Carneiro & Fernandez, 2010).

- Starting the project one year earlier to test the differences of first and second tests. On the other hand, if longer term is being given, future researchers might venture their investigation of false memory formation in long term memory using misinformation paradigm.

- Consider the mood factor into the research. For instance, improvement to mood by playing some relaxation music or video clip for participants before starting the test to sooth their feelings.

- Consider to investigate into the food regularly consumed by the participants to determine if nutrients could be a factor affecting one's ability to reject false memory formation.

5.4   Chapter Summary

This chapter summarises the whole research into a simplified overview and states the potential implications originated from the current research. Lastly, future directions on extended research are also being suggested in this section.

REFERENCES

Ajjawi, R. (2013, June). *Sample size in qualitative research*. Retrieved November 5, 2013, from Medical Education Research Network: http://blogs.cmdn.dundee.ac.uk/meded-research/2013/06/samplesize/

Awh, E. (2013). *Working memory and attention.* Retrieved November 5, 2013, from Go Cognitive: http://www.gocognitive.net/interviews/edward-awh-working-memory-and-attention

Baddeley, A. (1992, January 31). *Working memory*. Retrieved November 5, 2013, from PubMed.gov: http://www.ncbi.nlm.nih.gov/pubmed/1736359

Balota, D., & Duchek, J. (1989). Spreading activation in episodic memory: further evidence for age independence. *Q J Exp Psychol A*, 849-876.

Baym, C., & Gonsalves, B. (2010). Comparison of neural activity that leads to true memories, false memories, and forgetting: An fMRI study of the misinformation effect. *Cogn Affect Behav Neurosci*, 339-348.

Bell, B. G., & Cooke, N. J. (n.d.). *Cognitive ability correlates of performance on a team task.* Retrieved May 28, 2014, from Arizona State University East: http://www.cerici.org/media&pubs/documents/docs/COGNITIVE%20ABILITY%20CORRELATES%20OF.pdf

Bepko Learning Center. (2014). *Three learning styles*. Retrieved May 2, 2014, from Indiana University: http://blc.uc.iupui.edu/AcademicEnrichment/StudySkills/LearningStyles/3LearningStyles.aspx

Bernstein, D. M., & Loftus, E. F. (2009, March). *The consequences of false memories for food preferences and choices.* Retrieved October 6, 2013, from SAGE Journals: http://pps.sagepub.com/content/4/2/135.short

Bixter, M., & Daniel, F. (2013). Working memory differences in illusory recollection of critical lures. *Memory Cognition*.

Boggio, P., Fregni, F., Valasek, C., Ellwood, S., Chi, R., Gallate, J., et al. (2009). Temporal love cortical electrical stimulation during the encoding and retrieval phase reduces false memories. *PLoS One*.

Brainerd, C. J., & Reyna, V. F. (1990). *Gist is the grist: Fuzzy-trace theory and the new intuitionism.* Retrieved November 5, 2013, from IDML: http://www.idml.medicine.arizona.edu/Articles/Gist%20is%20the%20Grist%20Fuzzy%20Trace%20Theory%20and%20the%20New%20Intuitionis.pdf

Brainerd, C. J., & Reyna, V. F. (1998). Fuzzy-race theory and children's false memories. *Experimental of Child Psychology*, 81-129.

Brainerd, C., & Reyna, V. (2002, October 5). *Fuzzy-trace theory and false memory*. Retrieved Novemeber 17, 2013, from University of North Texas: http://www.unt.edu/rss/class/mike/5640/articles/fuzzytrace.pdf

Burmeister, E., & Aitken, L. M. (2011). *Sample size: How many is enpugh?* Retrieved November 2013, 2013, from Griffith University: http://www98.griffith.edu.au/dspace/bitstream/handle/10072/51545/83704_1.pdf?sequence=1

Cann, D. R., McRae, K., & Katz, A. N. (2011, August). *False recall in the Deese–Roediger–McDermott paradigm: The roles of gist and associative strength*. Retrieved October 7, 2013, from NCBI: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3226830/

Centre of Studies on Human Stress. (2014). *Effects of stress on memory*. Retrieved May 2, 2014, from Institut universitaire en santé mentale de Montréal: http://www.humanstress.ca/stress/effects-of-stress-on-memory/is-your-memory-affected-by-stress.html

Cherry, K. (2013a). *Gardner's theory of multiple intelligences*. Retrieved November 5, 2013, from About.com: http://psychology.about.com/od/educationalpsychology/ss/multiple-intell.htm

Cherry, K. (2013b). *What is short-term memory?* Retrieved November 5, 2013, from About.com: http://psychology.about.com/od/memory/f/short-term-memory.htm

Chicago Tribune. (2013). *False Memories.* Retrieved November 4, 2013, from Chicago Tribune: http://articles.chicagotribune.com/keyword/false-memories

Chisnell, D. (2010, February 19). *What you really get from a heuristic evaluation.* Retrieved October 11, 2013, from UX MAgazine: http://uxmag.com/articles/what-you-really-get-from-a-heuristic-evaluation

Cohen, D., & Crabtree, B. (2006, July). *Qualitative research guidelines project: Criterion sampling.* Retrieved November 17, 2013, from Robert Wood Johnson Foundation: http://www.qualres.org/HomeCrit-3814.html

Conway, A. R., & Engle, R. W. (1994). Working memory and retrieval: A resource-independent inhibition model. *Journal of Experimental Psychology*, 354-373.

Darsaud, A., Dehon, H., Lahl, O., Sterpenich, V., Boly, M., Dang-Vu, T., et al. (2011). Does sleep promote false memories? *Journal of Cognition and Neuroscience*, 26-40.

Dean, J. (2008, October 22). *False memories can influence behaviour.* Retrieved November 5, 2013, from Psyblog: http://www.spring.org.uk/2008/10/false-memories-can-influence-behaviour.php

DePaulo, P. (2000, December). *Sample size for qualitative research*. Retrieved November 5, 2013, from Quirk's Marketing Research Media: http://www.quirks.com/articles/a2000/20001202.aspx

Diekelmann, S., Born, J., & Wagner, U. (2010). Sleep enhances false memories depending on general memory performance. *Behav. Brain Res.*, 425-429.

Dye, L. (2013, April 14). *Real pictures can trigger false memories*. Retrieved November 17, 2013, from ABCNews: http://abcnews.go.com/Technology/story?id=99548

Elbow, S. (2010, December 21). *Memories on trial: Parents say therapists gave daughter false memories of abuse.* Retrieved November 12, 2013, from The Capital Times: http://host.madison.com/news/local/crime_and_courts/memories-on-trial-parents-say-therapists-gave-daughter-false-memories/article_56549e30-0c89-11e0-a44f-001cc4c03286.html

Eysenck, M. W., & Keane, M. T. (2005, April). *Theories of Forgetting.* Retrieved May 20, 2014, from Psychology Press: http://www.psypress.co.uk/ek5/resources/demo_ch06-sc-05.asp

Farewell, T. (2012). *Visual, auditory, kinesthetic learners*. Retrieved May 2, 2014, from Family Education by Pearson Education: http://school.familyeducation.com/intelligence/teaching-methods/38519.html

Fleming, G. (2013). *Multiple intelligence types*. Retrieved November 5, 2013, from About.com: http://homeworktips.about.com/od/learningstyles/ss/multiple.htm

Freyd, P. (2011). *Memory and reality.* Retrieved November 6, 2013, from False Memory Syndrome Foundation Online: http://www.fmsfonline.org/

Ganga, M. L. (1994, May 14). *Father wins suit in 'false memory' case.* Retrieved November 12, 2013, from Los Angeles Times: http://articles.latimes.com/1994-05-14/news/mn-57614_1_false-memories

Gardner, H. (2013). *The nine types of intelligence*. Retrieved November 5, 2013, from Skyview: http://skyview.vansd.org/lschmidt/Projects/The%20Nine%20Types%20of%20Intelligence.htm

Gathercole, S. E., & Alloway, T. P. (2007). *Understanding working memory.* Retrieved November 5, 2013, from Cognition and Brain Sciences Unit: http://www.mrc-cbu.cam.ac.uk/wp-content/uploads/2013/01/WM-classroom-guide.pdf

Gonsalves, B., Reber, P., Gitelman, D., Parrish, T., Mesulam, M., & Paller, K. (2004). Neural evidence that vivid imagining can lead to false remembering. *Psychol Sci*, 655-660.

Harsh, B. J. (2001, May). *Individual differences and the effectiveness of warnings __ In the DRM false memory paradigm_.* Retrieved November 5, 2013, from St. Mary's College of Maryland: http://www.smcm.edu/psyc/_assets/documents/SMP/Showcase/0001-BHarsh.pdf

Hogenboom, M. (2013, 29 September). *Why does the human brain create false memories?* Retrieved October 6, 2013, from BBC News: http://www.bbc.co.uk/news/science-environment-24286258

Howe, M. (1998). When distinctiveness fails, false memories prevail. *J.Exp. Child Psychology*, 170-177.

Hunt, E. (1980). Intelligence as an information-processing concept. *British Journal of Psychology*(71), 449-474.

Institut universitaire en santé mentale de Montré. (2013). *How stress affects memory?* Retrieved December 17, 2013, from Centre for Studies on Human Stress: http://www.humanstress.ca/stress/effects-of-stress-on-memory/is-your-memory-affected-by-stress.html

Johnson, M. K. (2001). *False memories, psychology of.* Retrieved October 6, 2013, from UCSD: http://mechanism.ucsd.edu/teaching/w07/philpsych/johnson.falsememories.pdf

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review*, 67-85.

Jou, J., & Flores, S. (2012). How are false memories distinguishable from true memories in the Deese-Roediger-McDermott paradigm? A review of the findings. *Psych. Res.*

Kane, M. J., & Engle, R. W. (2002). The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual differences perspective. *Psychonomic Bulletin & Review*, 637-671.

Katherine, B. (2012, December 24). *The 3 basic learning styles: How do you learn best?* Retrieved May 2, 2014, from WyzAnt Tutoring: http://www.wyzant.com/news/newsletters/97/the_3_basic_learning_styles_how_do_you_learn_best

Kember, D. (2000). Misconceptions about the learning approaches, motivation and study practices of Asian students. *High Education*, 99-121.

Kim, H., & Cabeza, R. (2007). Differential contributions of prefrontal, medial temporal, and sensory-perceptual regions to true and false memory formation. *Cereb Cortex*, 2143-2150.

Kluger, J. (2013, July 25). *Creating false memories in mice brains—and in yours.* Retrieved November 17, 2013, from TIME: http://science.time.com/2013/07/25/creating-false-memories-in-mice-brains-and-in-yours/

Kothari, C. R. (1990). *Research Methodology: Methods and Techniques.* Jaipur: New Age International Publishers.

Leding, J. K. (2012). *Working memory predicts the rejection of false memories.* Retrieved November 5, 2013, from Taylor&Francis Online: http://www.tandfonline.com/doi/abs/10.1080/09658211.2011.653373?journalCode=pmem20#.UnkodvlmjZk

Loepelmann, K. A. (2008, September 30). *The fuzzy trace theory.* Retrieved November 5, 2013, from Why Aren't You Studying?: http://whyarentyoustudying.blogspot.com/2008/09/fuzzy-trace-theory.html

Loftus, E. F. (1996). *Memory distortion and false memory creation.* Retrieved November 12, 2013, from Cogprints: http://cogprints.org/599/1/199802009.html

Loftus, E.F., & Palmer, J. (1974). Reconstruction of auto-mobile destruction: An example of the interaction between language an memory. *Journal of Verbal Learning and Verbal Behaviour*.

Loftus, E. F., & Pickrell, J. E. (1995, December). *The formation of false memories.* Retrieved October 6, 2013, from University of Washington: http://users.ecs.soton.ac.uk/harnad/Papers/Py104/loftusmem1.pdf

Marian, V. (2005). *Two memory paradigms: Genuine and false memoriesin wordlist and autobipgraphical recall.* Retrieved October 6, 2013, from Northwestern University: http://comm.soc.northwestern.edu/bilingualism-psycholinguistics/files/TwoMemoryParadigms.pdf

Mason, M. (2010). *Sample Size and Saturation in PhD Studies Using Qualitative Interviews*. Retrieved November 5, 2013, from Forum Qualitative Sozialforschung / Forum: Qualitative Social Research: http://www.qualitative-research.net/index.php/fqs/article/view/1428/3027

Mastin, L. (2010a). *Memory consolidation*. Retrieved December 17, 2013, from The Human Memory: http://www.human-memory.net/processes_consolidation.html

Mastin, L. (2010b). *Types of memory.* Retrieved November 13, 2013, from Luke Mastin: http://www.human-memory.net/types.html

Mayer, R. E., & Massa, L. J. (2003). Three facets of visual and verbal learners: Cognitive ability, cognitive style, and learning preference. *American Psychological Association*, 833-846.

McCabe, D. P. (2008). The role of covert retrieval in working memory span tasks: Evidence from delayed recall tests. *Journal of Memory and Language*, 40-494.

McCabe, D. P., Roediger, H. L., McDaniel, M. A., Balota, D. A., & Hambrick, D. Z. (2010). The relationship between working memory capacity and executive functioning: Evidence for a common executive attention construct. *Neuropsychology*, 222-243.

McConnell, M., & Hunt, R. (2007). Can false memories be corrected by feedback in the DRM paradigm? *Memory and Cognition*, 999-1006.

McLeod, S. (2007). *Stages of memory - Encoding storage and retrieval*. Retrieved December 17, 2013, from SimplyPsychology: http://www.simplypsychology.org/memory.html

Merskey, H. (1998). *Prevention and management of false memory syndrome.* Retrieved October 6, 2013, from RCPsych: http://apt.rcpsych.org/content/4/5/253.full.pdf

Miyake, A., & Shah, P. (1999). *Models of working memory: Mechanisms of active maintenance and executive control.* New York: Cambridge.

Nielsen, J. (1995). *Reliability of severity estimates for usability problems found by heuristic evaluation.* Retrieved October 11, 2013, from UFS: http://csi.ufs.ac.za/resres/files/p129-nielsen.pdf

Otgaar, H., Alberts, H., & Cuppens, L. (2012). *Ego depletion results in an increase in spontaneous false memories.* Retrieved November 5, 2013, from Personeel: http://www.personeel.unimaas.nl/henry.otgaar/Otgaar_EgoDepletionFM.pdf

Payne, J. S., & Ross, B. M. (2005, September). *Synchronous CMC, working memory, and L2 oral proficiency development*. Retrieved November 4, 2013, from Language Learning & Technology, Pennsylvania State University: http://llt.msu.edu/vol9num3/payne/default.html

Platt, R. D., Harsh, B. J., & Neuschatz, J. S. (2000). *The relationships among personality factors, metamemory, and two memory illusions.* New Orleans, LA: 41st annual meeting of Psychonomic Society.

Riding, R. J., & Watts, S. (1997). The effect of cognitive style on the preferred format of instructional material. *Educational Psychology*, 179-183.

Robinson, K. J., & Roediger, H. L. (1997). Associative processes in false recall and false recognition. *Psychological Science*, 231-237.

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology*, 803-814.

Sauro, J. (2010, August 31). *6 things you didn't know about heuristic evaluations.* Retrieved October 11, 2013, from Measuring Usability: http://www.measuringusability.com/blog/he.php

Silbermann, A. (2007). *Cognitive and personality differences leading to differential iduction of false memories.* Retrieved November 5, 2013, from Cornell University: https://www.google.com/search?q=Running+head%3A+INDIVIDUAL+D IFFERENCES+IN+SUSCEPTIBILITY+TO+FALSE+MEMORY&rlz=1 C1ASUT_enMY522&oq=Running+head%3A+INDIVIDUAL+DIFFERE NCES+IN+SUSCEPTIBILITY+TO+FALSE+MEMORY&aqs=chrome..6 9i57.2859231j0j4&sourceid=chrome&espv=210

Smith, K. (2008, July 14). *Sleep loss produces false memories*. Retrieved May 2, 2014, from Nature International Weekly Journal of science: http://www.nature.com/news/2008/080714/full/news.2008.953.html

Stark, C., Okado, Y., & Loftus, E. (2010). Imaging the reconstruction of true and false memories using sensory reactivation and the misinformation paradigms. *Learn Memories*, 485-488.

Storbeck, J. (2013). *Negative affect promotes encoding of and memory for details at the expense of the gist: Affect, encoding, and false memories.* Retrieved November 5, 2013, from Taylor&Francis Online: http://dx.doi.org/10.1080/02699931.2012.741060

Straube, B. (2012). An overview of the neuro-cognitive processes involved in the encoding, consolidation, and retrieval of true and false memories. *Behavioural and Brain Functions*, 1-10.

Strauss, V. (2013, October 16). *Howard Gardner: 'Multiple intelligences' are not 'learning styles'.* Retrieved November 5, 2013, from The Washington Post: http://www.washingtonpost.com/blogs/answer-sheet/wp/2013/10/16/howard-gardner-multiple-intelligences-are-not-learning-styles/

Storbeck, J. (2013). *Negative affect promotes encoding of and memory for details at the expense of the gist: Affect, encoding, and false memories.* Retrieved November 5, 2013, from Taylor&Francis Online: http://dx.doi.org/10.1080/02699931.2012.741060

Trafton, A. (2013, July 25). *Neuroscientists plant false memories in the brain.* Retrieved November 17, 2013, from MIT News: http://web.mit.edu/newsoffice/2013/neuroscientists-plant-false-memories-in-the-brain-0725.html

UCTI. (2010, April 30). *Calculating your GPA & CGPA.* Retrieved November 6, 2013, from UCTI: http://webapps.apiit.edu.my/servlet/retrieveStudentForm?ID=8&Retrieve Header1=Content-Disposition&RetrieveHeader2=attachment;filename=UCTI%20GPA%20 &%20CGPA%20Calculation%20sample.pdf;

Underwood, B., & Postman, L. (1960). Extra-experimental sources of interference in forgetting. *Psychological Review*(67), 73-95.

Unsworth, N., & Brewer, G. (2010). Individual differences in false recall: A latent variable analysis. *Journal of Memory and Language*, 19-34.

Vanhorn, D. (2011). *Coglab Manual.* Canada: Wadsworth Cengage Learning.

Van, D. I. (2012). Mood and the DRM paradigm: An investigation of the effects of valence and arousal on false memory. *The Quarterly Journal of Experimental Psychology.*

Vitelli, R. (2012, November 4). *Implanting false memories.* Retrieved November 12, 2013, from Psychology Today: http://www.psychologytoday.com/blog/media-spotlight/201211/implanting-false-memories

Voytek, B. (2013, May 20). *How can we enhance working memory?* Retrieved November 5, 2013, from BrainFacts.org: http://blog.brainfacts.org/2013/05/how-can-we-enhance-working-memory/#.UnjvePlmjZk

Watson, J. M., Bunting, M. F., Poole, B. J., & Conway, A. R. (2005). *Individual differences in susceptibility to false memory in the Deese-Roediger-McDermott paradigm.* Retrieved November 5, 2013, from Princeton: http://www.princeton.edu/~aconway/pdf/false_memories_2005.pdf

Zhu, B., Chen, C., Loftus, E. F., He, Q., Chen, C., Lei, X., et al. (2011, December 15). *Brief exposure to misinformation can lead long-term false memories.* Retrieved October 6, 2013, from Wiley Online Library: http://onlinelibrary.wiley.com/doi/10.1002/acp.1825/abstract

Zhu, B., Chen, C., Loftus, E. F., Lin, C., & Dong, Q. (2013). The relationship between DRM and misinformation false memories. *Memory and Cognition*.

Zhu, B., Chen, C., Loftus, E. F., Lin, C., He, Q., Chen, C., et al. (2010, July 8). *Individual differences in false memory from misinformation: Cognitive factors.* Retrieved November 5, 2013, from Taylor&Francis Online: http://www.tandfonline.com/doi/abs/10.1080/09658211.2010.487051#.Un krM_lmjZk

Appendix A – Extended Details for Results in Chapter 4 (Tables and Figures - Scatter Dot Diagrams)

A.   CGPA

1. Relationship between CGPA and Ability of Rejecting False Memory Formation (Word Recognition)

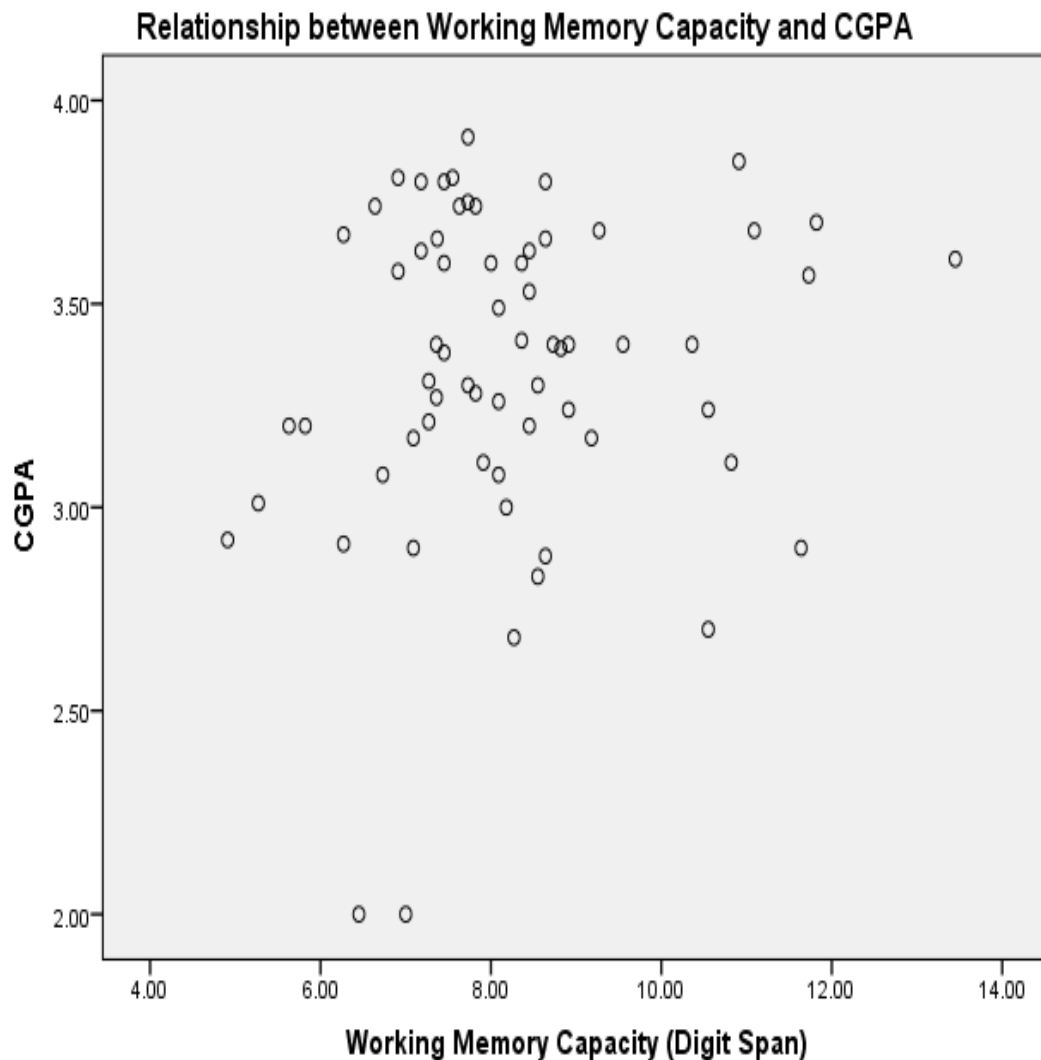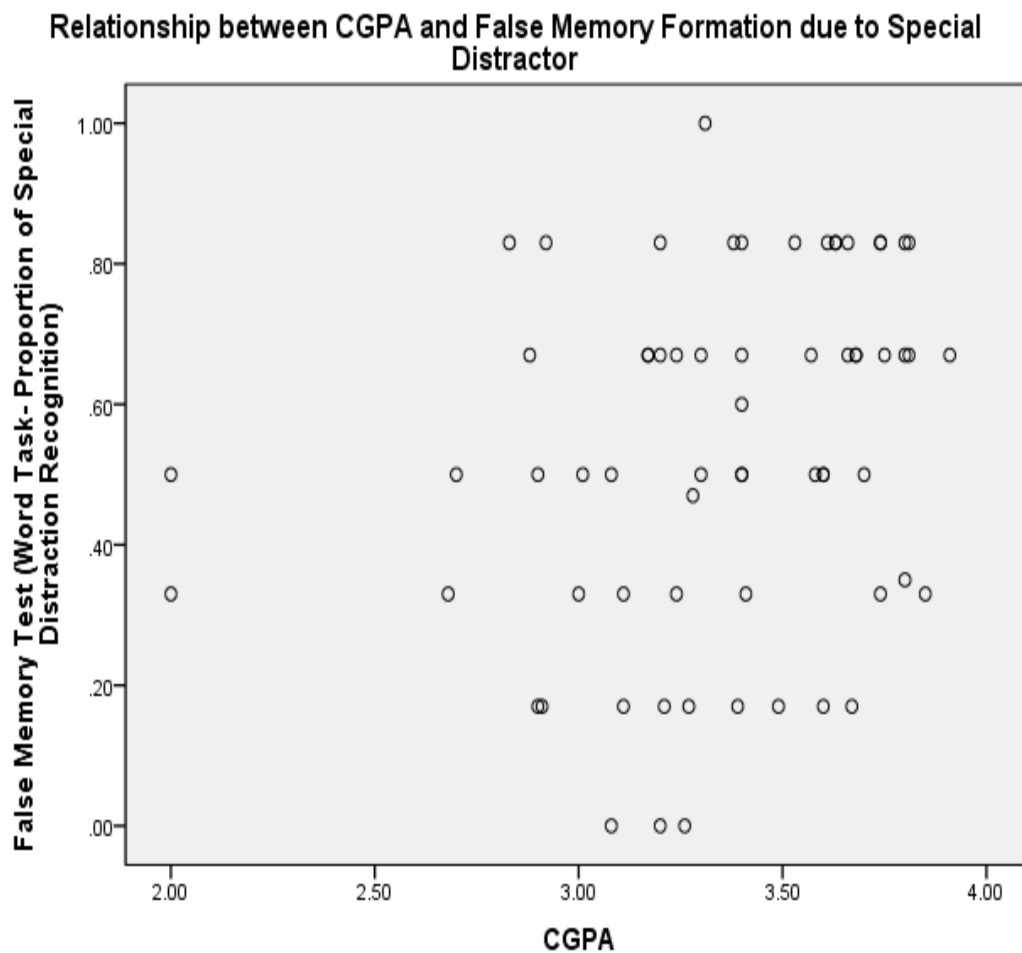|	
Null Hypothesis, H_o	There is no relationship between students' CGPA and ability of rejecting false memory formation (word recognition) in word task.
Alternative Hypothesis, H_a	There is a relationship between students' CGPA and the ability of rejecting false memory formation (word recognition) in word task.
Variables	Students' CGPA; and students' ability of rejecting false memory formation (word recognition) in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.6: Relationship between CGPA and Ability of Rejecting False Memory Formation (Word Recognition)
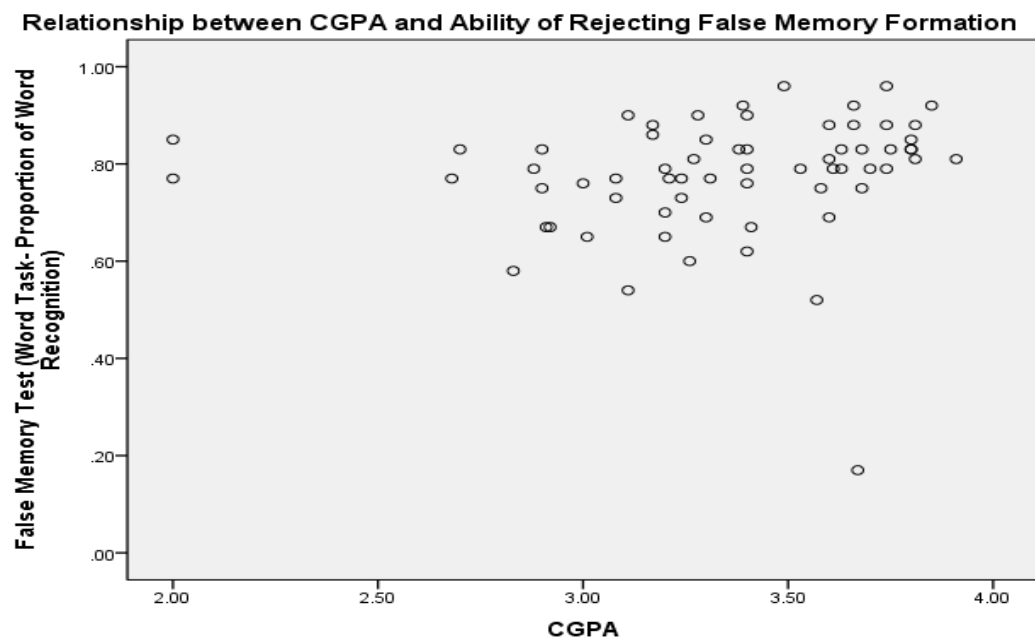
Figure 4.1: Relationship between CGPA and Ability of Rejecting False Memory Formation (Word Recognition)

2. *Relationship between Working Memory Capacity (WMC) and CGPA*

Null Hypothesis, H_o	There is no association between students' working memory capacity (WMC) and CGPA.
Alternative Hypothesis, H_a	There is an association between students' working memory capacity (WMC) and CGPA.
Variables	Students' working memory capacity (WMC); and students' CGPA
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.7: Relationship between Working Memory Capacity (WMC) and CGPA

Figure 4.2: Relationship between Working Memory Capacity (WMC) and CGPA

3. Relationship between CGPA and False Memory Formation due to Special Distractor

Null Hypothesis, H_o	There is no relationship between students' CGPA and false memory formation due to special distractor in word task.
Alternative Hypothesis, H_a	There is a relationship between students' CGPA and false memory formation due to special distractor in word task.
Variables	Students' CGPA; and students' false memory formation due to special distractor in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

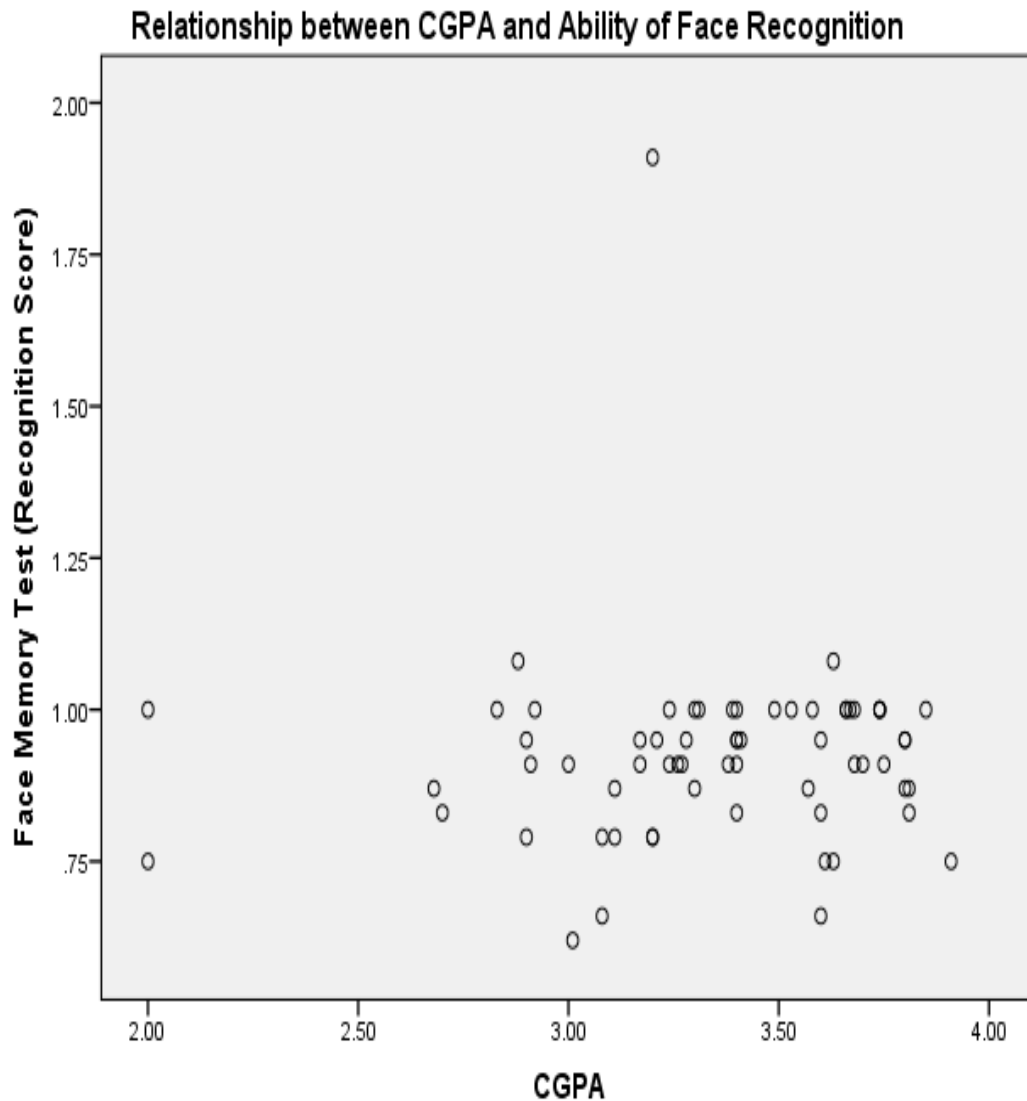*Table 4.8: Relationship between CGPA and False Memory Formation due to Special Distractor*

Figure 4.3: Relationship between CGPA and False Memory Formation due to Special Distractor

4. Relationship between CGPA and False Memory Formation due to Distractor

Null Hypothesis, H_o	There is no relationship between students' CGPA and false memory formation due to distractor in word task.
Alternative Hypothesis, H_a	There is a relationship between students' CGPA and false memory formation due to distractor in word task.
Variables	Students' CGPA; and students' false memory formation due to distractor in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

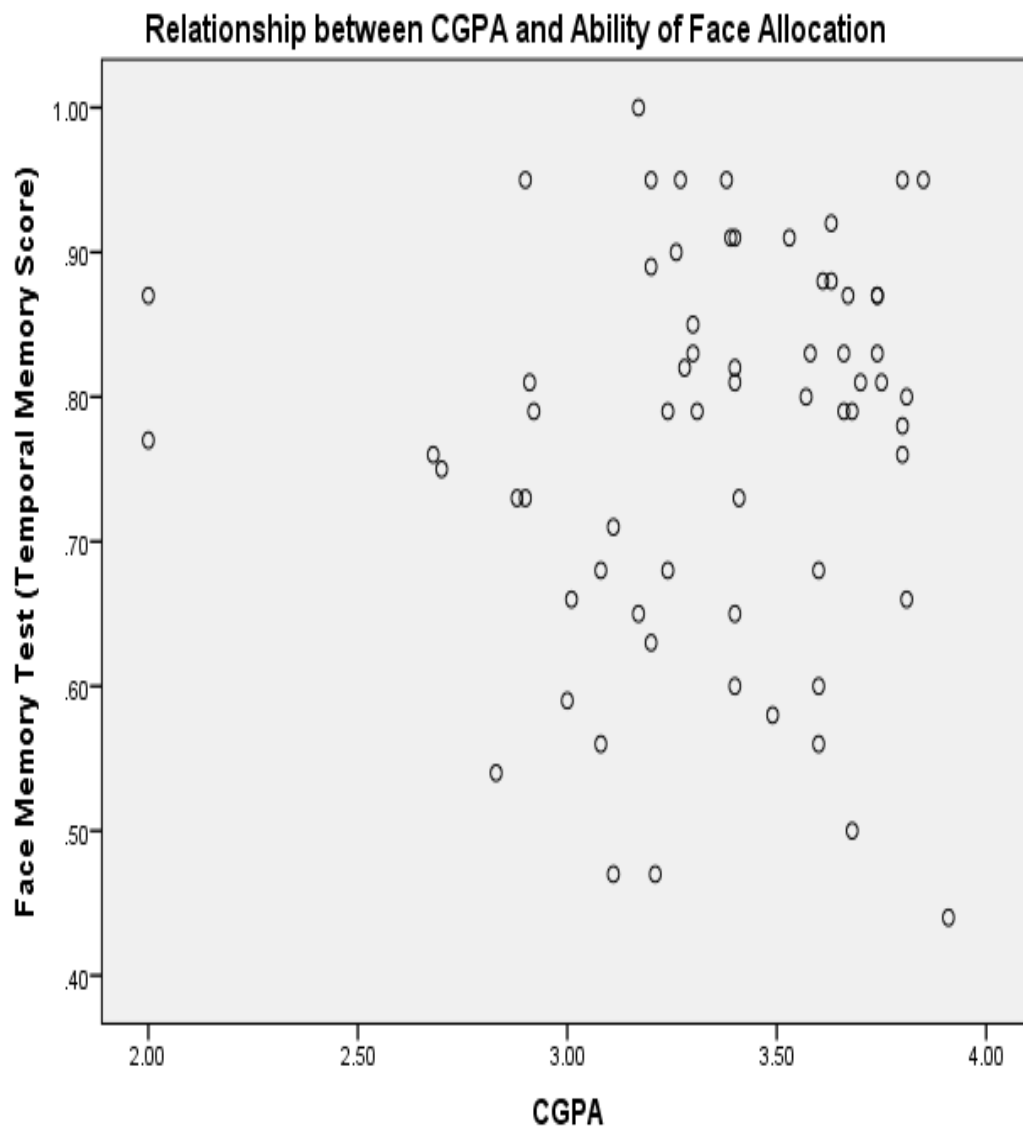*Table 4.9: Relationship between CGPA and False Memory Formation due to Distractor*
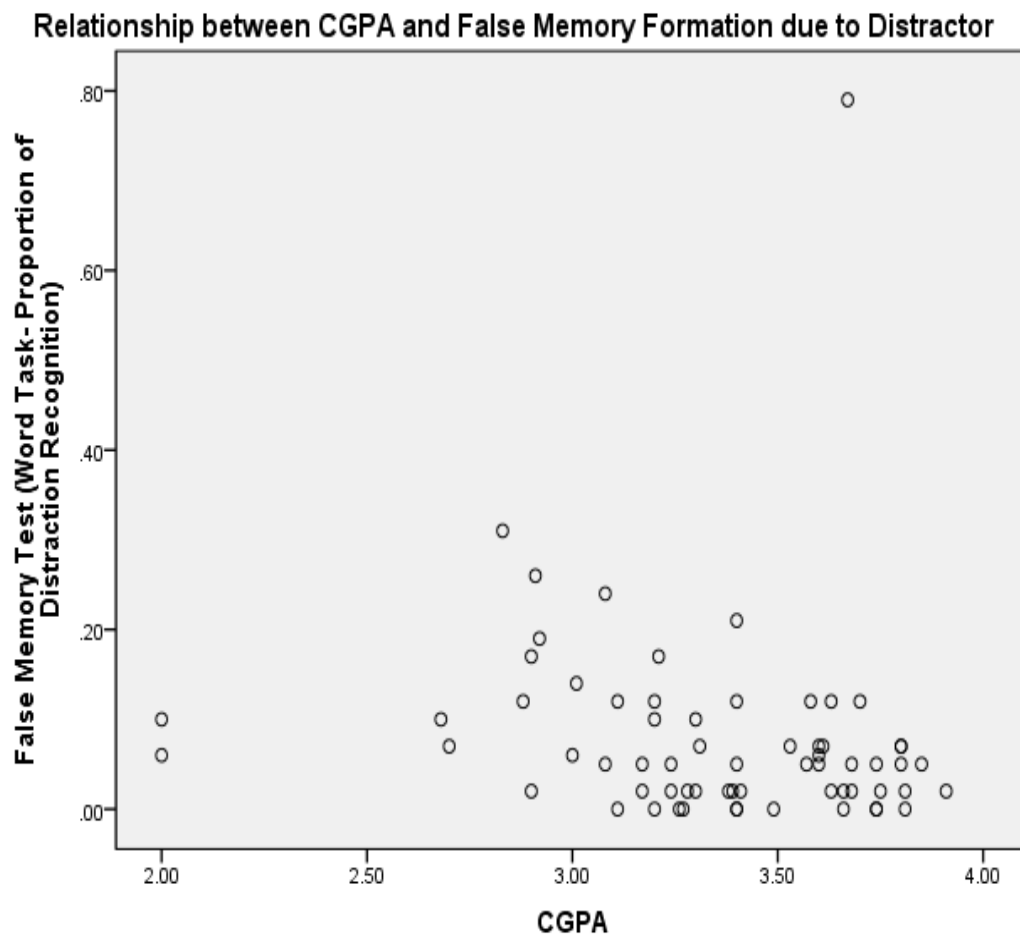
Figure 4.4: Relationship between CGPA and False Memory Formation due to Distractor

5. *Relationship between CGPA and Ability of Face Recognition*

Null Hypothesis, H_o	There is no association between students' CGPA and ability of face recognition as in picture task.
Alternative Hypothesis, H_a	There is an association between students' CGPA and ability of face recognition as in picture task.
Variables	Students' CGPA; and students' ability of face recognition as in picture task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.10: Relationship between CGPA and Ability of Face Recognition

Figure 4.5: Relationship between CGPA and Ability of Face Recognition

6. Relationship between CGPA and Ability of Face Allocation

Null Hypothesis, H_o	There is no association between students' CGPA and ability of face allocation as in picture task.
Alternative Hypothesis, H_a	There is an association between students' CGPA and ability of face allocation as in picture task.
Variables	Students' CGPA; and students' ability of face allocation as in picture task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.11: Relationship between CGPA and Ability of Face Allocation

Figure 4.6: Relationship between CGPA and Ability of Face Allocation

B.   WMC

1. Relationship between Working Memory Capacity (WMC) and Ability of Rejecting False Memory Formation (Word Recognition)

Null Hypothesis, H$_o$	There is no relationship between students' working memory capacity (WMC) and ability of rejecting false memory formation (word recognition) in word task.
Alternative Hypothesis, H$_a$	There is a relationship between students' working memory capacity (WMC) and ability of rejecting false memory formation (word recognition) in word task.
Variables	Students' working memory capacity (WMC); and students' ability of rejecting false memory formation (word recognition) in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.12: Relationship between Working Memory Capacity (WMC) and Ability of Rejecting False Memory Formation (Word Recognition)
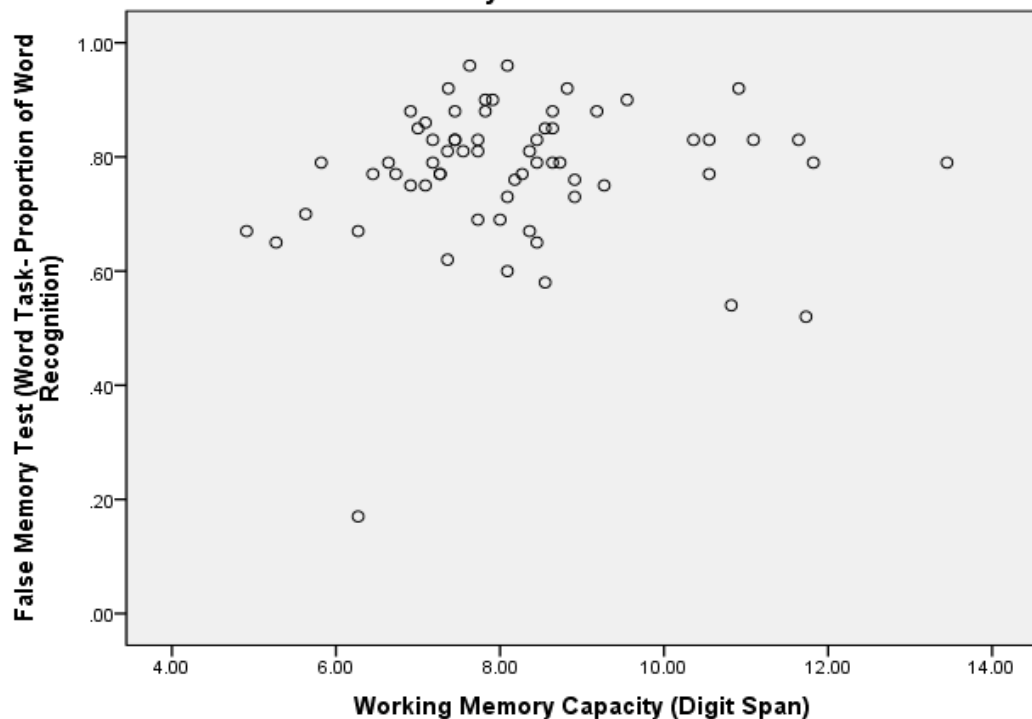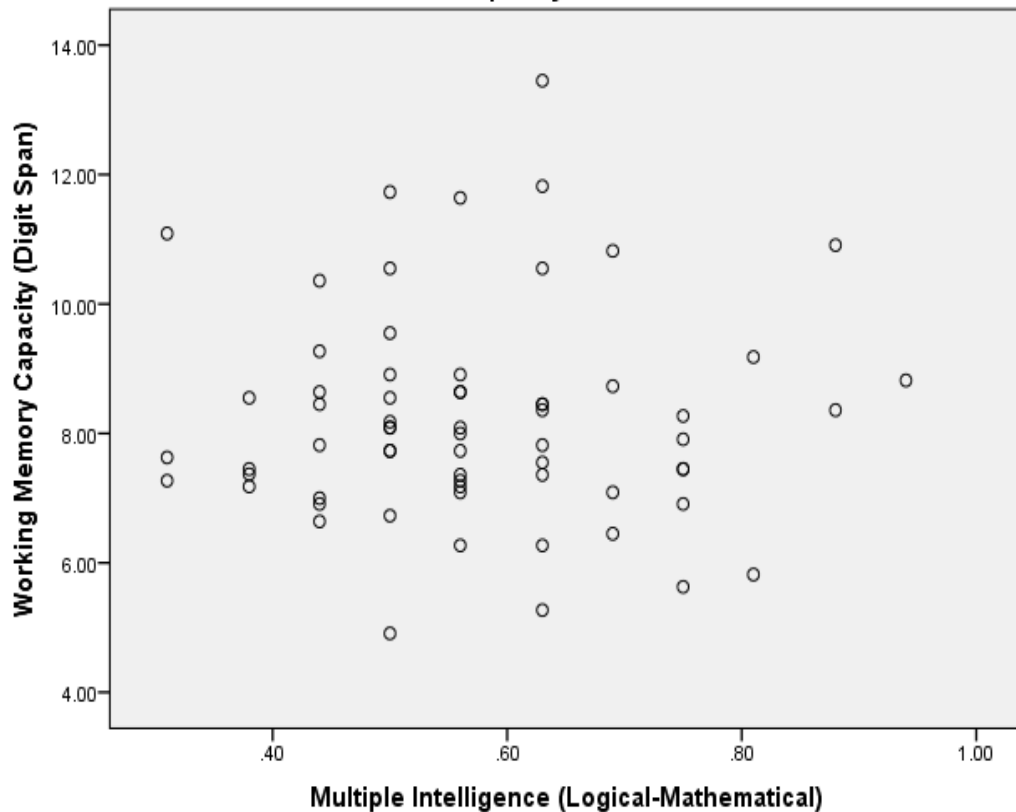

Figure 4.7: Relationship between Working Memory Capacity (WMC) and Ability of Rejecting False Memory Formation (Word Recognition)

2. *Relationship between Logical-Mathematical Intelligence and Working Memory Capacity (WMC)*

Null Hypothesis, H_o	There is no association between students' logical-mathematical intelligence (one of the multiple intelligences component) and working memory capacity (WMC).
Alternative Hypothesis, H_a	There is an association between students' logical-mathematical intelligence (one of the multiple intelligences component) and working memory capacity (WMC).
Variables	Students' logical-mathematical intelligence score; and students' working memory capacity (WMC)
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.13: Relationship between Logical-Mathematical Intelligence and Working Memory Capacity (WMC)

Figure 4.8: Relationship between Logical-Mathematical Intelligence and Working Memory Capacity (WMC)

3. Relationship between Visual-Spatial Intelligence and Working Memory Capacity (WMC)

Null Hypothesis, H_o	There is no association between students' visual-spatial intelligence (one of the multiple intelligences component) and working memory capacity (WMC).
Alternative Hypothesis, H_a	There is an association between students' visual-spatial intelligence (one of the multiple intelligences component) and working memory capacity (WMC).
Variables	Students' visual-spatial intelligence score; and students' working memory capacity (WMC)
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

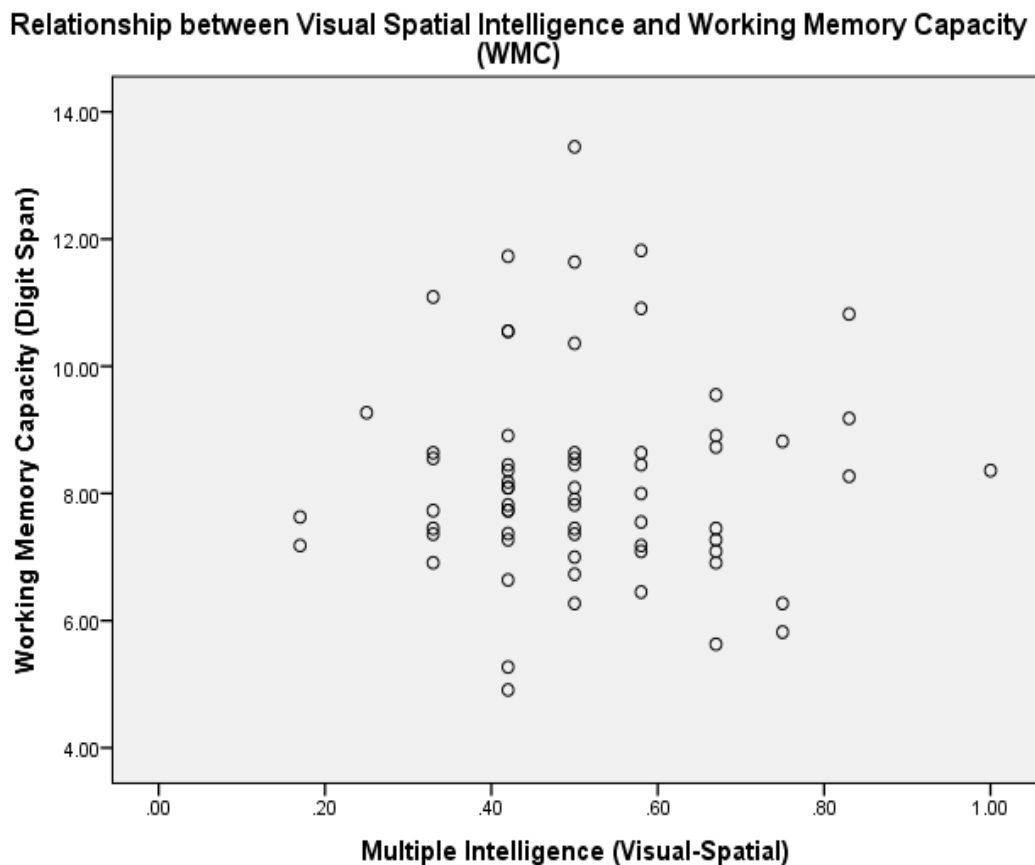*Table 4.14: Relationship between Visual-Spatial Intelligence and Working Memory Capacity (WMC)*

Figure 4.9: Relationship between Visual-Spatial Intelligence and Working Memory Capacity (WMC)

4. Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Special Distractor

Null Hypothesis, H_o	There is no relationship between students' working memory capacity (WMC) and false memory formation due to special distractor in word task.
Alternative Hypothesis, H_a	There is a relationship between students' working memory capacity (WMC) and false memory formation due to special distractor in word task.
Variables	Students' working memory capacity (WMC); and students' false memory formation due to special distractor in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.15: Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Special Distractor
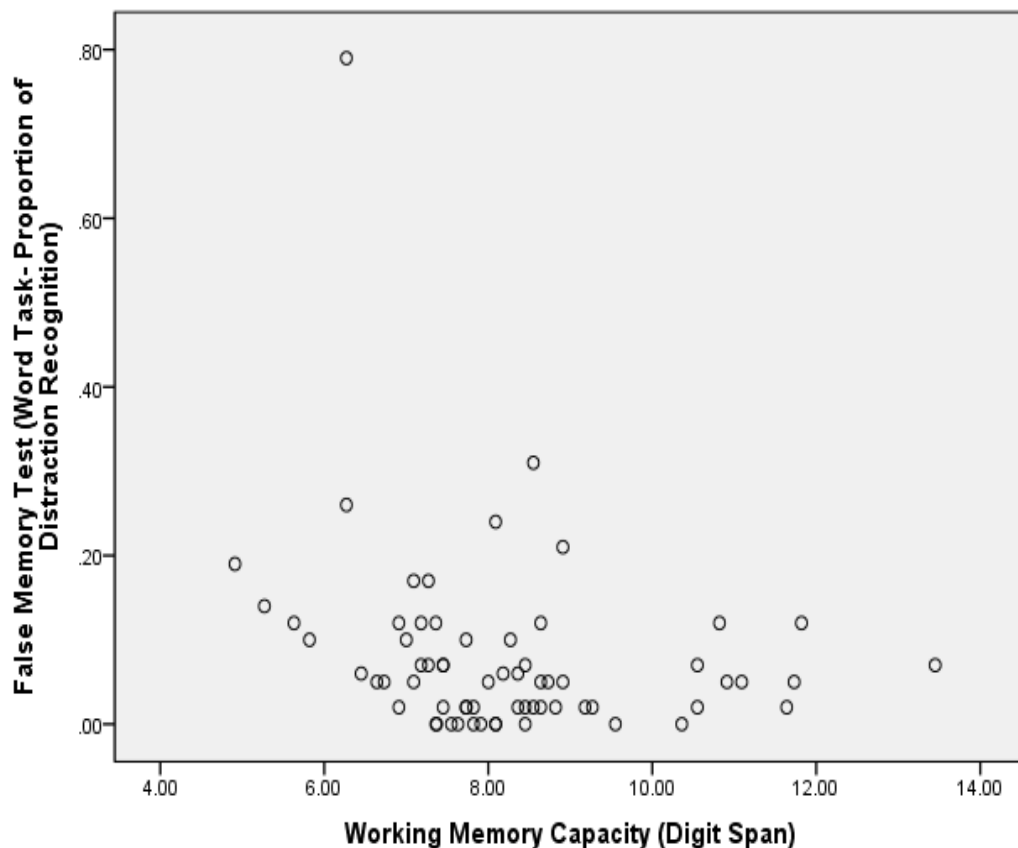

Figure 4.10: Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Special Distractor

5. ***Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Distractor***

Null Hypothesis, H$_o$	There is no relationship between students' working memory capacity (WMC) and false memory formation due to distractor in word task.
Alternative Hypothesis, H$_a$	There is a relationship between students' working memory capacity (WMC) and false memory formation due to distractor in word task.
Variables	Students' working memory capacity (WMC); and students' false memory formation due to distractor in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.16: Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Distractor

Figure 4.11: Relationship between Working Memory Capacity (WMC) and False Memory Formation due to Distractor

C.   Multiple Intelligence

- **Verbal-Linguistic Intelligence**

1.   *Relationship between Verbal-Linguistic Intelligence and Ability of Rejecting False Memory Formation (Word Recognition)*

Null Hypothesis, H_o	There is no association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and ability of rejecting false memory formation (word recognition) in word task.
Alternative Hypothesis, H_a	There is an association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and ability of rejecting false memory formation (word recognition) in word task.
Variables	Students' verbal-linguistic intelligence score; and students' ability of rejecting false memory formation (word recognition) in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.17: Relationship between Verbal-Linguistic Intelligence and Ability of Rejecting False Memory Formation (Word Recognition)
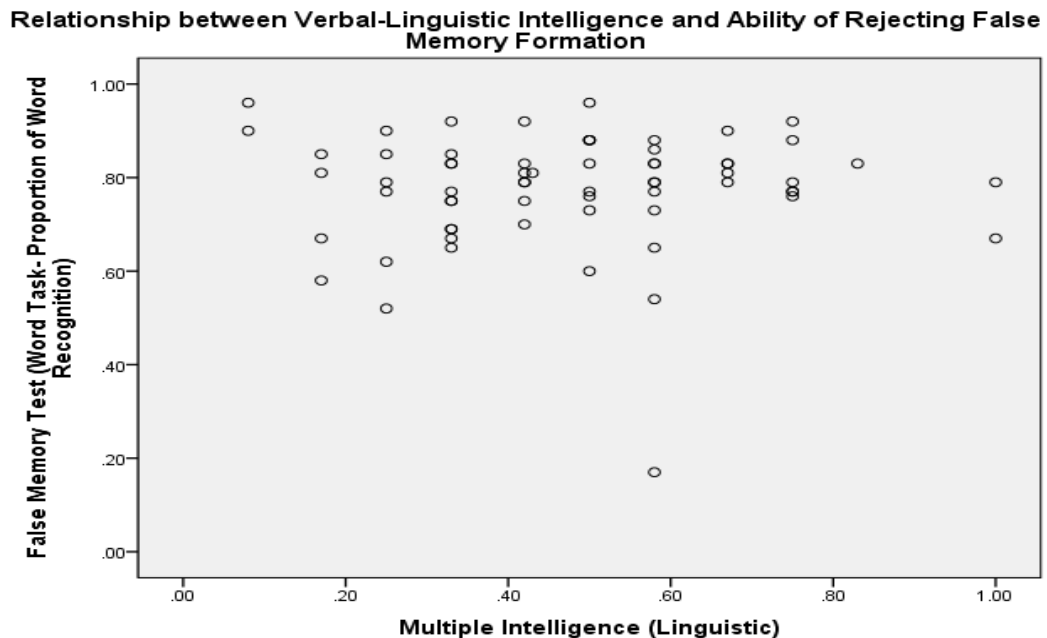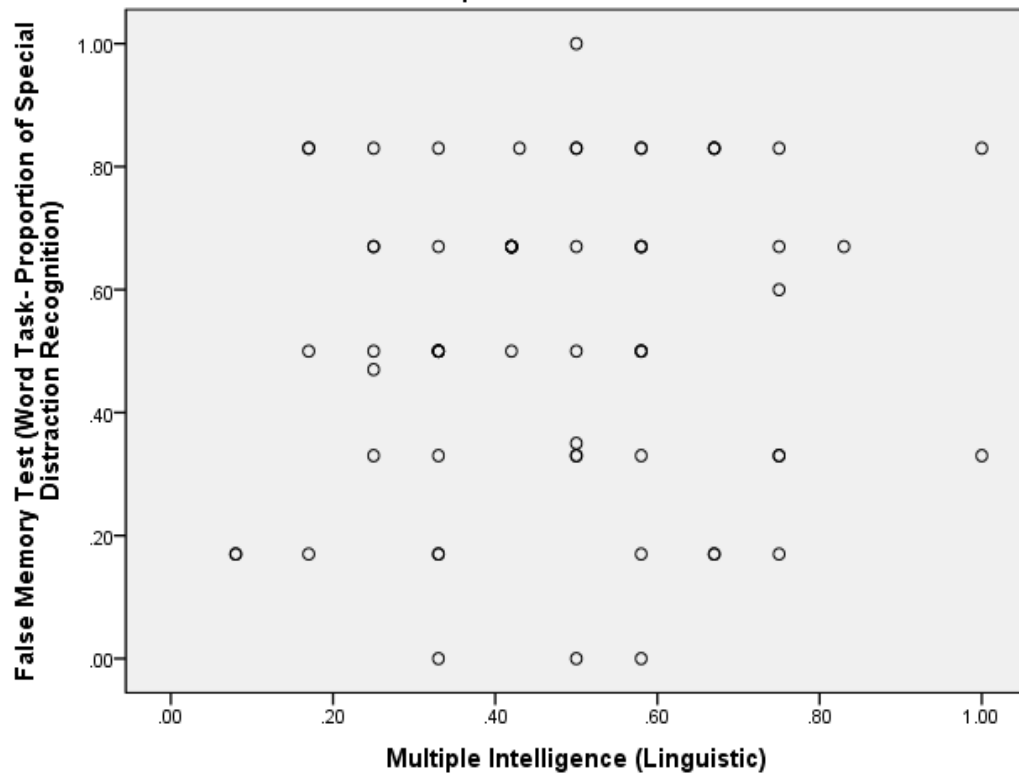

Figure 4.12: Relationship between Verbal-Linguistic Intelligence and Ability of Rejecting False Memory Formation (Word Recognition)

2. Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Special Distractor

Null Hypothesis, H_o	There is no association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and false memory formation due to special distractor in word task.
Alternative Hypothesis, H_a	There is an association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and false memory formation due to special distractor in word task.
Variables	Students' verbal-linguistic intelligence score; and students' false memory formation due to special distractor in word task
Findings: Inferential Statistics Test Used	Pearson Product-Moment Correlation Analysis

Table 4.18: Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Special Distractor

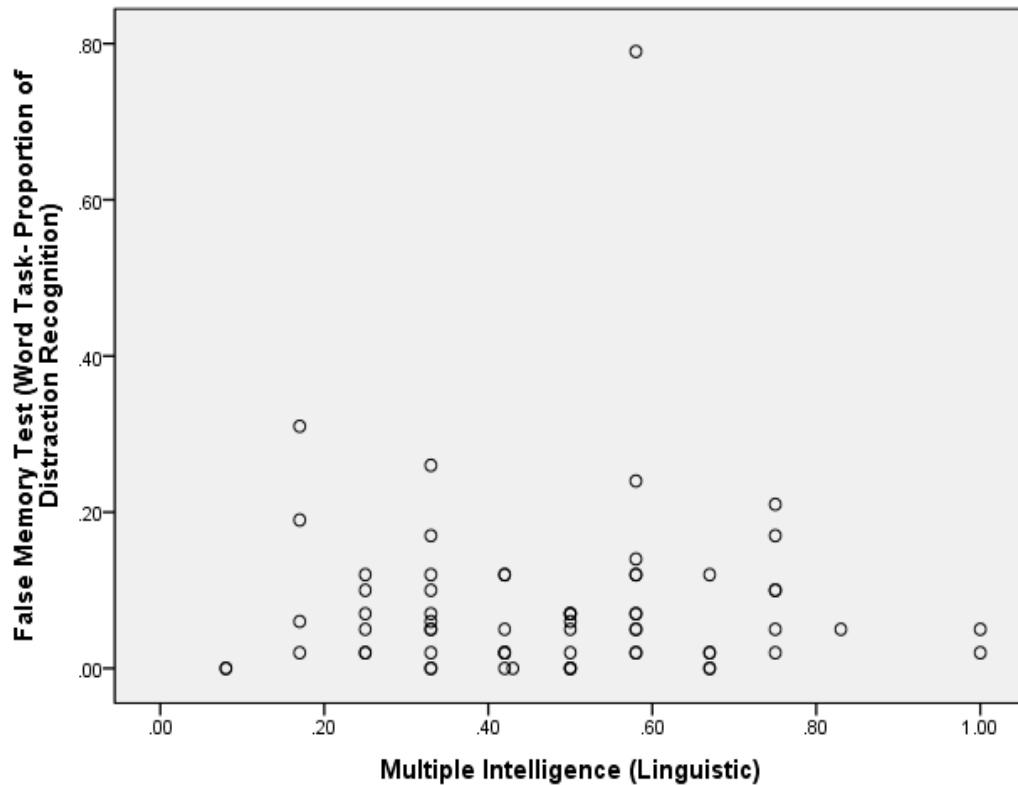Figure 4.13: Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Special Distractor

3. Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Distractor

Null Hypothesis, H_o	There is no association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and false memory formation due to distractor in word task.
Alternative Hypothesis, H_a	There is an association between students' verbal-linguistic intelligence (one of the multiple intelligences component) and false memory formation due to distractor in word task.
Variables	Students' verbal-linguistic intelligence score; and students' false memory formation due to distractor in word task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

Table 4.19: Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Distractor

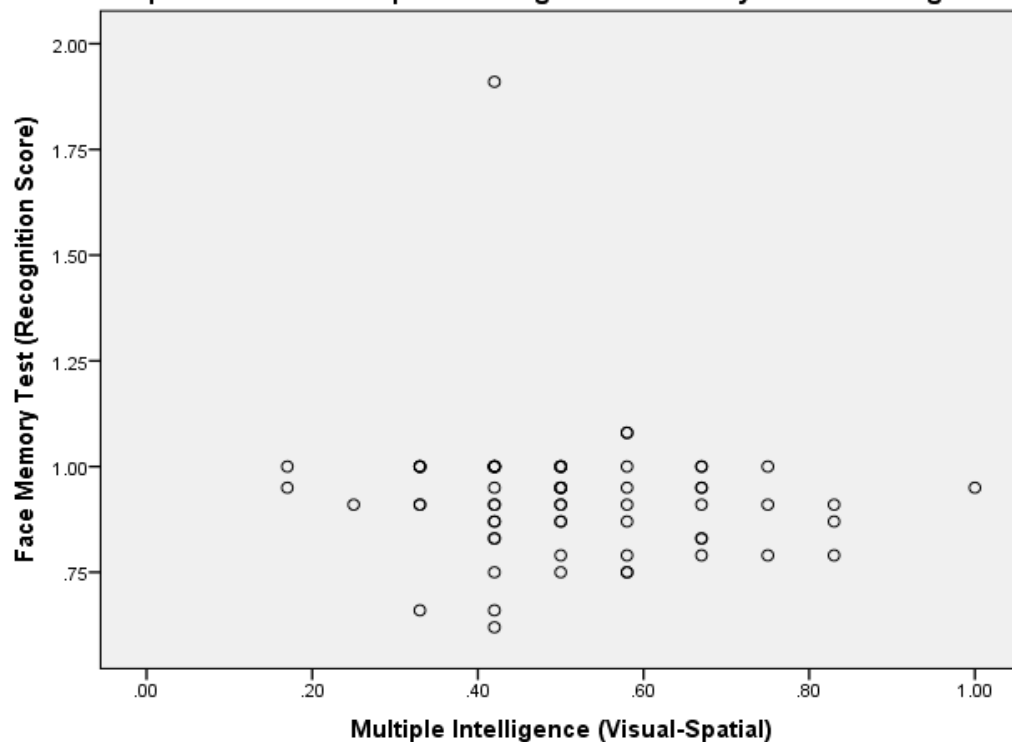Figure 4.14: Relationship between Verbal-Linguistic Intelligence and False Memory Formation due to Distractor

- **Visual-Spatial Intelligence**

1. ***Relationship between Visual-Spatial Intelligence and Ability of Face Recognition***

Null Hypothesis, H_o	There is no association between students' visual-spatial intelligence (one of the multiple intelligences component) and ability of face recognition as in picture task.
Alternative Hypothesis, H_a	There is an association between students' visual-spatial intelligence (one of the multiple intelligences component) and ability of face recognition as in picture task.
Variables	Students' visual-spatial intelligence score; and students' ability of face recognition as in picture task
Findings: Inferential Statistics Test Used	Spearman's Rank-Order Correlation Analysis

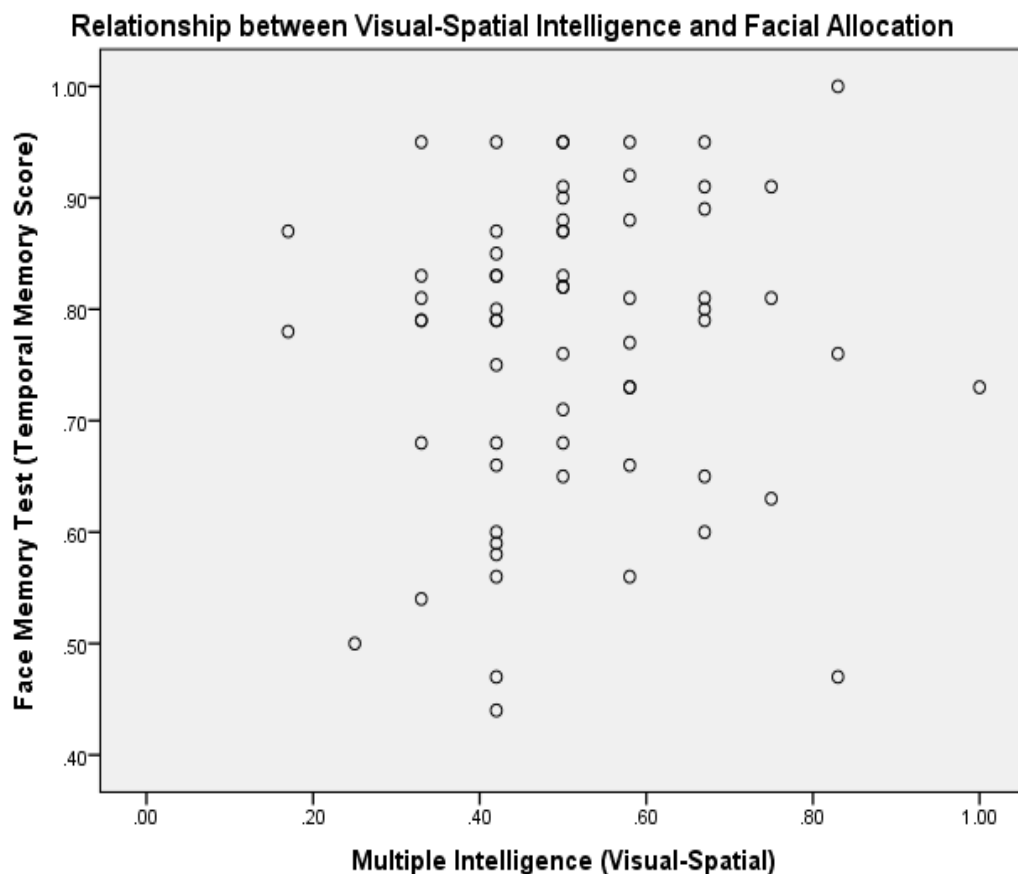*Table 4.20: Relationship between Visual-Spatial Intelligence and Ability of Face Recognition*

Figure 4.15: Relationship between Visual-Spatial Intelligence and Ability of Face Recognition

101

2. *Relationship between Visual-Spatial Intelligence and Facial Allocation*

Null Hypothesis, H_o	There is no association between students' visual-spatial intelligence (one of the multiple intelligences component) and ability of face allocation as in picture task.
Alternative Hypothesis, H_a	There is an association between students' visual-spatial intelligence (one of the multiple intelligences component) and ability of face allocation as in picture task.
Variables	Students' visual-spatial intelligence score; and students' ability of face allocation as in picture task
Findings: Inferential Statistics Test Used	Pearson Product-Moment Correlation Analysis

Table 4.21: Relationship between Visual-Spatial Intelligence and Facial Allocation

Figure 4.16: Relationship between Visual-Spatial Intelligence and Facial Allocation

D. Prediction of CGPA using Various Components of False Memory Formation

Null Hypothesis, H_o	The various components of false memory formation in word task cannot be used to predict the students' CGPA.
Alternative Hypothesis, H_a	The various components of false memory formation in word task can be used to predict the students' CGPA.
Variables	Various component of false memory formation (ability of rejecting false memory formation, false memory formation due to special distractor & false memory formation due to distractor); and students' CGPA
Independent Variable	Various component of false memory formation (ability of rejecting false memory formation, false memory formation due to special distractor & false memory formation due to distractor)
Dependent Variable	Students' CGPA
Findings: Inferential Statistics Test Used	Multiple Linear Regression Analysis

Table 4.22: Prediction of CGPA using Various Components of False Memory Formation

E. Prediction of false memory formation due to distractor using CGPA and WMC

| Null Hypothesis, H_o	The components CGPA and WMC cannot be used to predict the students' false memory formation due to distractor.
Alternative Hypothesis, H_a	The components CGPA and WMC can be used to predict the students' false memory formation due to distractor.
Variables	Students' CGPA; WMC; and false memory formation due to distractor
Independent Variable	Students' CGPA and WMC
Dependent Variable	Students' false memory formation due to distractor
Findings: Inferential Statistics Test Used	Multiple Linear Regression Analysis

Table 4.23: Prediction of false memory formation due to distractor using CGPA and WMC

Appendix B – Sample Photos of Research

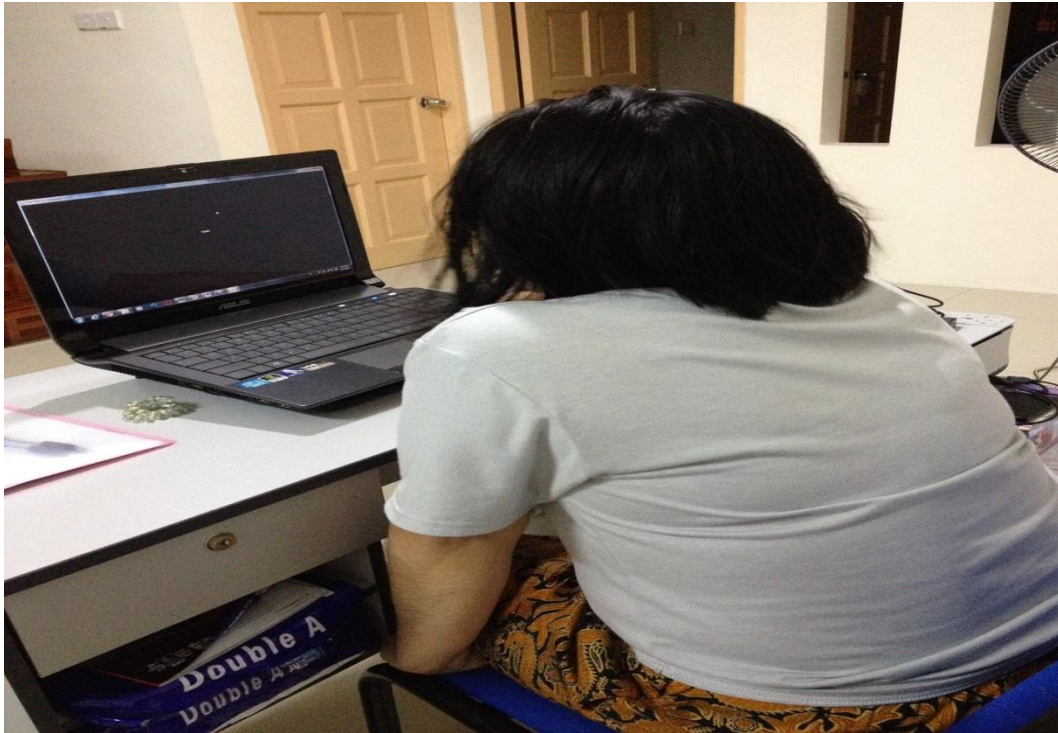*Photo B.1: Sample photo of participant taking the multiple intelligence test*
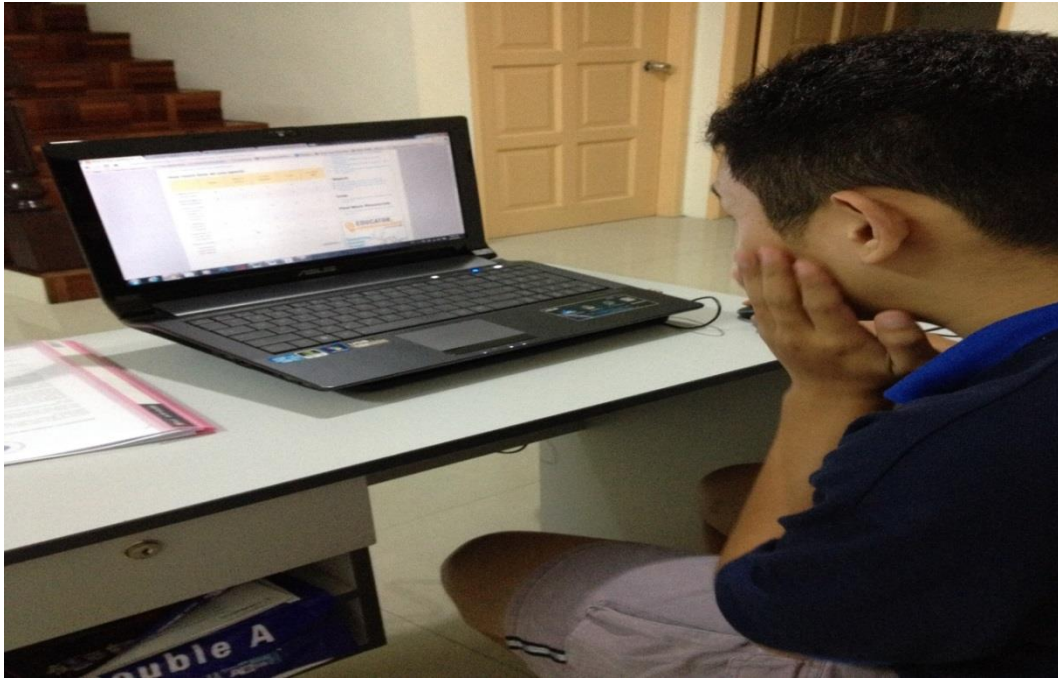
Photo B.2: Sample photo of participant taking the working memory capacity test
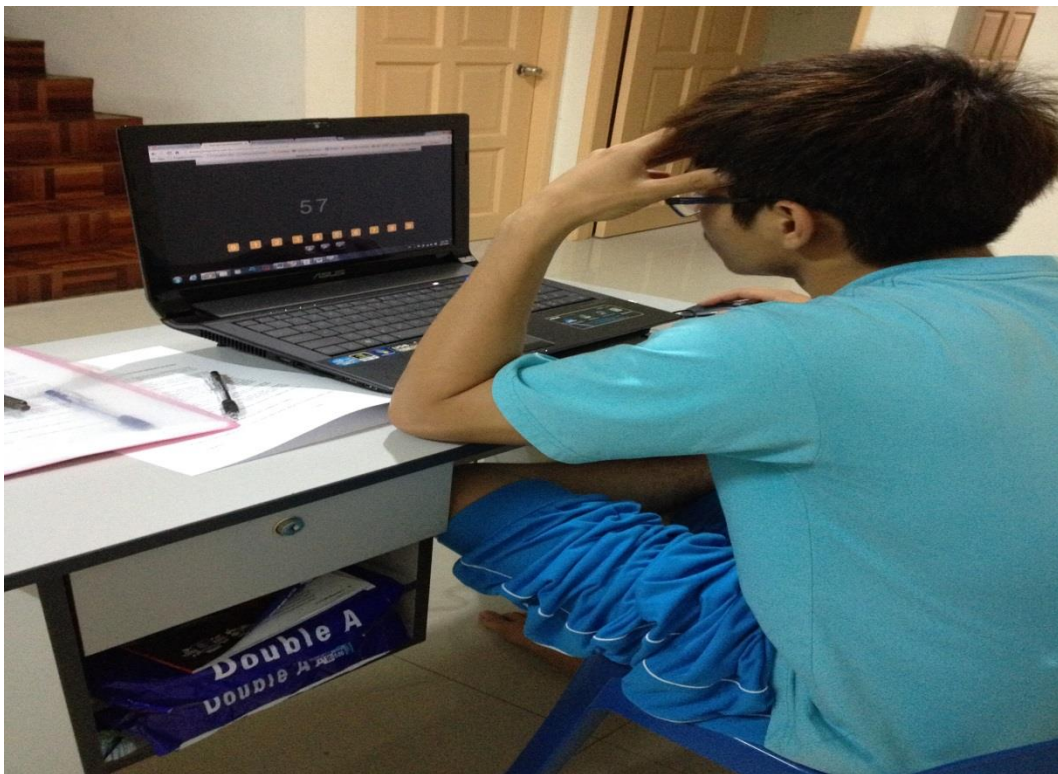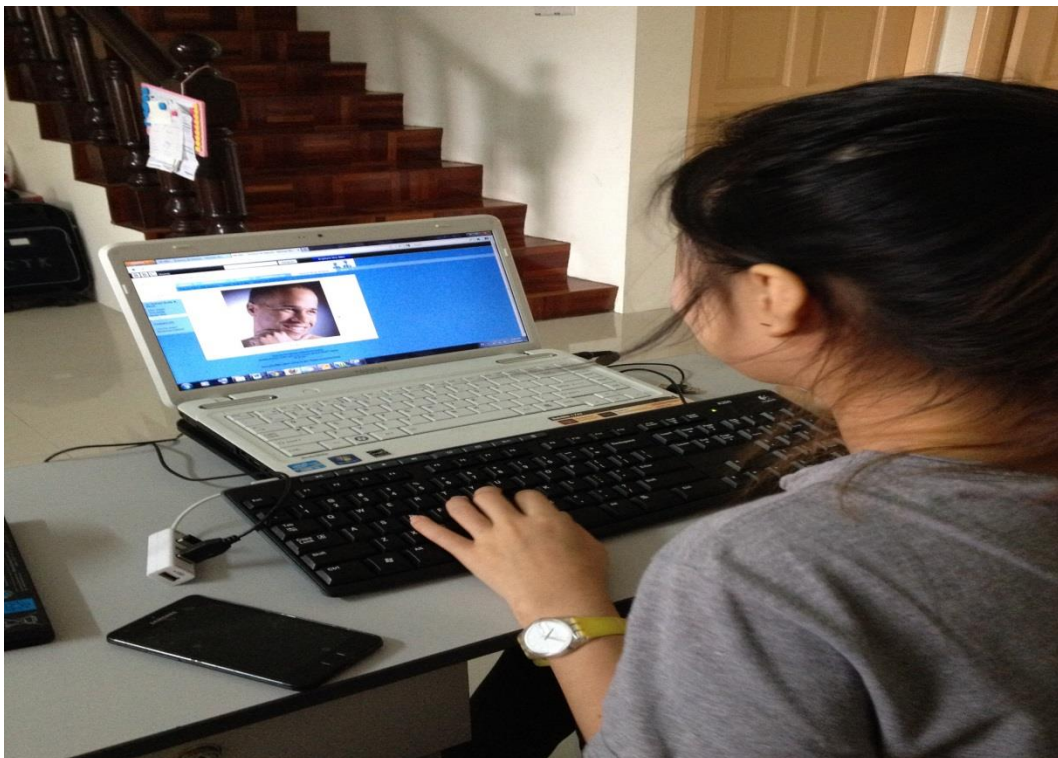
Photo B.3: Sample photo of participant taking the false memory test

Photo B.4: Sample photo of participant taking the face recognition test

EXPERIMENTAL TESTING FOR *FACTORS CONTRIBUTING TO FALSE MEMORY IN SHORT TERM MEMORY*

You are invited to participate in a research study about the Factors Contributing to False Memory in Short Term Memory. The goal of this research study is to determine the relationship between CGPA, multiple intelligences and working memory capacity with false memory.

This study is being conducted by Choo Boon Linn (29914) in order to complete the final year project for the course KMK 3104 Final Year Project 2 under the supervision of Dr. Tan Kock Wah from the Faculty of Cognitive Sciences and Human Development.

Any undergraduates above Semester 1 are qualified to participate in the experimental testing.

Participation in this study is voluntary. If you agree to participate in this study, you would be taking the tests for about 30 minutes or more. These included the false memory test for word task and pictorial task, multiple intelligences test and working memory test. Besides name, gender, ongoing semester, faculty, course, university, age, and CGPA, no other specific personal details are required, this is however, photo (s) may be taken during the process in order to assist me in the analysis later. You may leave your email address in the provided space if you would like to receive a copy of your results and the outcome of the study soon.

Participating in this study may not benefit you directly, but it will help me to learn about study. And your willingness in participating in the experimental testing will be deeply appreciated while the experience might be useful to you in the future.

The information you share with me if you participate in this study will be kept completely confidential to the full extent of the law. When the study is completed and the data have been analyzed, findings will be presented only in summary form and your name would not be used in any report.

If you have any questions about this study, you are most welcome to approach me for further enquiries.

Please sign to prove that you have read the terms and condition. Thanks.

I, _____ have been fully noted about the research study and I am agree in participating in it.

Signature: _____   Date: _____

PARTICULAR FORM

Participant #_____ (Post-Test)

Name: _____

Age: _____   **Gender:** Female / Male

Name of Institution: University of Malaysia Sarawak /

                      Others,   please   specify:

                      _____

Faculty: _____

Course: _____

Semester: 1 / 2, Year 1 / 2 / 3 / 4 / 5

Latest CGPA Achieved: _____

Date of Experiment Conduction: _____

Did you have enough sleep last night? Roughly how many hours?

☐Yes ☐No **;** ☐Less than 1hr ☐1 – 3hrs ☐3 – 5hrs ☐5 – 7hrs ☐At least 8hrs

---

Note: If you would like to receive a copy of your results and the outcome of the study soon, please fill in your email address in the space provided below:

Email Address: _____

~ Thanks for your cooperation. The details provided will strictly remain as private and

confidential. ~