



**Faculty of Cognitive Sciences and Human
Development**

The Relationship between Anxiety, Stress, and Working Memory Capacity

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Final Year Project Report

Masters

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The Relationship between Anxiety, Stress, and Working Memory Capacity

Hanan Ahmed Ali Al-Fakih

This project is submitted in partial
fulfilment of the requirements for a
Bachelor of Psychology with Honours

Faculty of Cognitive Sciences and Human Development
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(2021)

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Abstract

This study designed a quantitative research to identify the relationship between anxiety, stress, and working memory capacity (WMC). The study aims to test the differences between anxiety levels in WMC and the correlation between stress and WMC. The research used a quasiexperiment method where 16 participants were assigned into online assessments to measure anxiety and stress levels, then, they were invited to attend face-to-face task to measure WMC. The study adopted the Beck Anxiety Inventory (BAI) assessment to measure anxiety, the Perceived Stress Scale (PSS-10) assessment to measure stress, and the Operation Span Task to measure WMC. Analysis of the collected data demonstrated that there are no significant differences between anxiety levels in WMC, also, there is no significant correlation between stress and WMC. Overall, the result indicates that anxiety and stress do not influence the capacity of WM. In fact, the research's findings are opposite to pervious research that have shown a decline in WMC due to high anxiety and stress. For this reason, this experimental research emphasis on the need for further studies of this relationship. However, this study has some limitations in terms of sample size, the variety of WMC task, and the availability of appropriate location.

Chapter 1: Introduction

1.0 Overview

This research aims in studying the relationship between anxiety, stress, and working memory capacity. In this chapter, an introduction of the study, background of the study, and problem statement are covered. Besides, the chapter clarify the objectives of the study, research questions and hypothesis, conceptual framework, and significance of the study. Finally, the definition of the terms is stated.

1.1 Introduction

Nowadays, anxiety and stress consider the most common mental health crisis that people struggle with, since it is related to emotional, social, functional burden (Vytal, Comwell, Letkiewicz, Arkin, & Grillon, 2013). In 2020, these mental issues have significantly increased due to the global pandemic. According to the American Psychiatric Association (APA), 62% of the population, in USA, suffer from anxiety (Hemavathi, Johan, Pritiss, Chow, & Ng Chong, 2020), and based on A National Mental Health survey, around 7 in 10 (68%) claims that they experienced high level of stress during the current critical time (“Stress in America”, 2020).

Lukasik, Waris, Soveri, Lehtonen, and Laine (2019) stated that anxiety has the feature in limiting the control of over worrying thoughts and attentional biases because a great focus is wasting on negative stimuli, and, under stressful statues, the controlled attention resources are declined since they are managed by the potential threat (Klein and Boals, 2001).

In term of attention control, working memory capacity (WMC) plays a major role. It refers to the ability of using attention in order to maintain information in active, conscious state and decreased distracted thoughts (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008). Numerous studies have shown that WMC has a crucial function in variation of cognitive demand process such as executive function, problem solving (Wily, & Jarosz, 2012), making decision (Corbin, McElroy, & Back, 2010), and self-regulation (Hofmann et al, 2008).

Therefore, this study aims to find out if anxiety and stress level could determine the capacity of working memory through assigning twenty undergraduate UNIMAS students to run out an online experiment named Automated Operation Span Tasks (OSpan).

1.2 Background of the Study

Working memory considers the leader of numerous functions that required a cognitive process such as goal- directed behaviors, problem solving, making decision and emotion control. Basically, it is significant system in manipulation, encoding, and retrieving data (Oliver, Andrea, & Klaus, 2013). It was first introduced by Miller, Galanter, and Pribram (1960 as cited in Gruszka, & Nęcka, 2017). After that, Baddeley and Hitch, in 1974, proposed WM as multicomponent system of information storage and processing, and they developed Baddeley's model of WM (Gruszka, & Nęcka, 2017).

Baddeley's model investigated three subcomponents for working memory including verbal WM (phonological loop), visual WM (visuospatial sketchpad), and the central executive (Baddeley and Hitch, 1974; Baddeley, 2000b as cited in Oliver et al, 2013). Central executive is the head of this system that manipulate, retain, and coordinates information between the other subcomponents (verbal WM and visual WM) which enable human to produce meaningful cognitive process, and visuospatial sketchpad (visual WM) is responsible to process and store visual and spatial information while phonological loop (verbal WM) manages written and

speech- based information (Oliver et al, 2013). Later, in 2000, Baddeley came out with new element of WM which is episodic buffer. Episodic buffer was regarded as a temporary storage system that modulates and integrates different sensory information (Baddeley, 2000a as cited in Oliver et al, 2013).

According to Wilhelm, Hildebrandt, and Oberauer (2013), working memory capacity (WMC) is studied as individual differences theory that reflect a person's level on working memory. However, Gruszka, & Nęcka (2017) stated that WMC was defined differently through three theoretical views which are the executive attention view (Engle, 2002), the primary/secondary memory view (Unsworth & Engle, 2007 as cited in Gruszka, & Nęcka, 2017), and the binding hypothesis (Oberauer, 2009). Based on executive attention view, WMC refers to the ability of using attention to maintain or suppress information (Engle, 2002). To be more precise, WMC does not indicate to individual's ability in storing as much as maintaining information in working memory system to be actively retrieved with minimal interfered thoughts (Engle, 2002, p. 20).

In the primary/secondary memory view, WMC is determined by the variation in maintenance (primary memory) and retrieval (secondary memory) ability of information (Unsworth & Engle, 2007 as cited in Gruszka, & Nęcka, 2017). To describe it more precisely, primary memory plays a role in maintaining relevant representations items to be activated, and these items are retrieved from secondary memory (i.e., long term memory store) which is required cue-dependent search (Gruszka, & Nęcka, 2017). Therefore, people with low WMC have lower performance when active maintenance is needed and retrieving relevant information which weaken accessing to goal-relevant information. Moreover, 'the limited capacity of working memory arises from interference between bindings, which effectively limits the

complexity of new structural representations, and thereby constrains reasoning ability' (Wilhelm, Hildebrandt, & Oberauer 2013, p. 4).

In addition, many literatures showed a clear correlation between WMC and working memory-related cognitive functions. For instance, problem solving is one of cognitive demand which required a strong collaboration from WMC to achieve successful performance (Wily, & Jarosz, 2012). Wily and Jarosz (2012) study WMC in problem-solving process especially mathematical problem solving, Raven's progressive matrix (RPM) problem solving, and creative problem solving, and they found high capacity of working memory led to effective problem-solving process because it enhances the function of store information, retrieve required information, narrow focusing on the solution, control irrelevant information.

Furthermore, many studies proved a relationship between WMC and making decision because it allows variety in encoding information strategies; as a result, high WMC will help individuals to produce superior decision-making whilst low WMC will limit individual's ability on rote-rehearsal which make them less sensitive to risky choice (Corbin, McElroy, & Black, 2010).

Moreover, abundant researchers indicate that executive functions significantly associated with WMC (McCabe, Roediger III, McDaniel, Balota, & Hambrick, 2010). Executive function takes responsibility for goal-directed behaviors, self-control, concentration, and adjusting with changes (Diamond, 2013). McCabe et al. (2010) conduct a study on the relationship between executive functions and WMC, and they asserted that these systems are highly related which make it irrational to consider them separated components.

In fact, the theory of WMC is usually applied in individual differences studies. Nevertheless, researchers theorized that WMC can be conceptualized as both a stable trait and transient state

(Gruszka, & Nęcka, 2017), and, based on the state WMC concept, various factors can either impairment or enhance working memory capacity (WMC) because the system is sensitive to be triggered by our diet, lifestyle, and emotions. Numbers of researchers were interested in discovering the influence of anxiety and stress on WM capacity and the possible effect of these common emotional status on the cognitive process that associated to WMC.

Human experiences variation of emotions as an interaction with the environment and the surrounded people, and these emotion conditions could be either positive or negative. Anxiety and stress identified as responses for unpleasant life's events. Based on American Psychological Association (2020):

“stress is defined as emotional responses for an external event which could be a short- term trigger such as a work deadline or a fight with a loved one or it may be a long-term trigger, such as being unable to work, discrimination, or chronic illness. Individuals under stress suffer from mental and physical symptoms such as irritability, anger, fatigue, muscle pain, digestive troubles, and difficulty sleeping while anxiety is defined as a persistent, excessive worries that present even with the absent of external trigger. Anxiety cause a nearly identical set of symptoms as stress: insomnia, difficulty concentrating, fatigue, muscle tension, and irritability” (para. 1).

1.3 Problem Statement

Numbers of researchers conducted studies to discover the relationship between anxiety, stress, and working memory capacity (Darke, 1988; Sorg & Whitney, 1992; Lukasik, Waris, Soveri, Lehtonen, & Laine, 2019; Luethi, Meier, & Sandi, 2009; Klein, & Boals, 2001). In fact, anxiety took a large concern from different authors, but they were interested in identifying the

interaction between anxiety and WMC in term of individual differences. They compared between high anxious and low anxious individuals' performance in WMC task.

Moreover, these researchers measured participants WMC by applying either digit span task or reading and word span task. They determined individual's capacity based on the numbers of recalled items in these tasks. Also, some authors used multiple tasks such as complex span tasks and n-back tasks.

However, the present research is adopting the concept of WMC as a transient state and not personal trait. Thus, it is exploring the correlation tendency between anxiety and WMC, and stress and WMC. The experiment aims in finding out weather the level of anxiety and stress can determine WMC.

Furthermore, this study uses the operation span task (OSpan) to measure WMC. The difference between OSpan task and digit span task is that participants need to solve an operation while interfered item is presented, and then they need to recall the items in correct order. It measures participants in maintaining attention. On the other hand, digit span task measures the ability in store and manage information where participant must memories presented items then recall them in the presented order and reverse order.

In studying anxiety, previous researcher determined specific sort of anxiety weather trait anxiety or state anxiety, and State-Trait Anxiety Inventory (STAI) is usually used. Nevertheless, this study is looking to anxiety as a whole where participants are asked to which extend the experiences an anxiety feature based on Back Anxiety Inventory (BAI). As well, stress was seen, in past studies, as a situational response, and it measured after the experimenter run out a stressor event. On the other hand, the current experiment studies stress as ongoing mental issue through measuring participant's stress level using Perceived Stress Scale (PSS) assessment.

1.4 Objectives of the study

1.4.1 Main Objective

This study mainly aims to identify the relationship between anxiety, stress, and working memory capacity.

1.4.2 Specific Objectives

1. To identify the differences between anxiety levels in working memory capacity.
2. To identify the relationship between stress and on working memory capacity.

1.5 Research Question

1. What are the differences between anxiety levels in working memory capacity?
2. What is the relationship between stress and working memory capacity?

1.6 Research Hypothesis

H₁= There are significant differences between the levels of anxiety in working memory capacity (Objective 1).

H₂ = There is a significant correlation between stress and working memory capacity (objective 2).

1.7 Conceptual Framework of Research

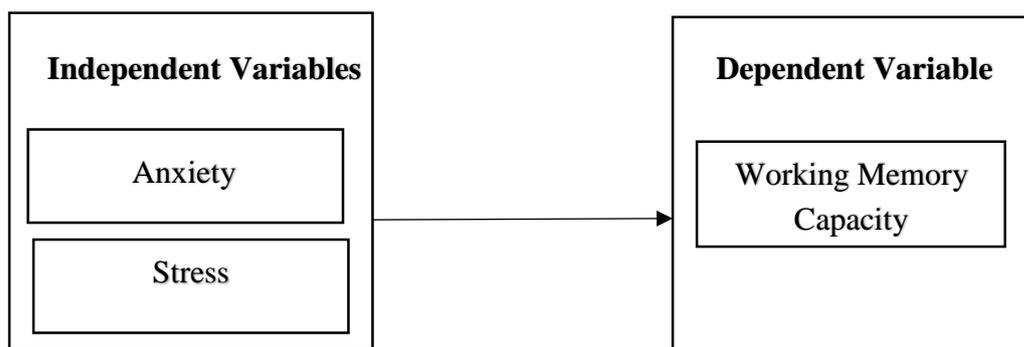


Figure 1.7 Conceptual Framework

1.8 Significance of the Study

This study is designed to find out the relationship between anxiety, stress, and working memory capacity among UNIMAS university students. The importance of studying the mentioned relationship is gaining further information about the possible influence of the emotions on the cognitive function which is predicted to impact people's daily activities and performance either directly or indirectly.

In addition, the present study conducts among university students, and, in this lifespan, individuals are moving to a different stage in life where they need to be cognitively healthy in order to make decision, solve problem, and preform goal-directed behavior. Therefore, such study would bring more attention on a major cognitive component like WMC that play a role in these processes.

Besides, university students are likely to experience severe anxiety or stress because university is a competitive environment where they must compete with themselves as well as with their peers. Also, students have different responsibilities including their academic achievement such as functional matters. As a result, such finding would be an awareness to students or even lectures about the mental statues and numbers of cognitive- related declined performance, and how similar emotional crisis can decrease their academic achievement.

1.9 Definitions of the terms

1.9.1 Definitions of Anxiety

Conceptual Definition

Anxiety is unpleasant emotion that could be characterized as apprehension, tension, or discomfort thoughts following with physical responses such as that associated with a sense of danger which could occur with no triggered object or event (Xi, 2020).

Operational Definition

In the present study, anxiety is defined based on participant's experience of specific anxiety symptoms in Beck Anxiety Inventory (BAI) during the past month.

1.9.2 Definitions of Stress

Conceptual Definition

Stress is defined psychologically as a feeling of mental press and tension which can be caused either by external stimuli or the internal perceptions of the person (Shahsavarani, Abadi, & Kalkhoran, 2015) *Operational Definition* stress is operationally defined as scored high perceived stress in the Perceived Stress Scale

(PSS) which is determined based on participant's feelings and thoughts during the last month.

1.9.3 Definitions of Working Memory Capacity

Conceptual Definition

Wilhelm, Hildebrandt, and Oberauer (2013) defined working memory capacity as individual differences in term of the personal level in working memory efficiency (Gruszka, & Nečka, 2017).

Operational Definition

The working memory capacity is defined based on participant ability to recall displayed information during processing a second interfering task (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008).

1.10 Summary

To sum, this study conducted to discover the relationship between anxiety, stress, and working memory capacity. Similar study is important to understand the relation between emotions and cognitive aspect. This chapter include introduction about the topic, background of the study, and problem statement. Also, the chapter explain the objectives of the study, research questions, research hypothesis, conceptual framework, the significance of the study.

Finally, it provides the conceptual and operational definition of the terms.

Chapter two: Literature Review

2.1 Introduction

This chapter provides an overview of past literatures that discussed the relationship between anxiety, stress, and working memory capacity. The review starts with an introduction of the research variables following by two main sections where present the previous finding in the relationship between anxiety and working memory capacity, also, the relationship between stress and working memory capacity.

2.1.1 The Concept of Anxiety and stress

Due to the rapid change of modern life and an absence of peace (Xi, 2020), anxiety become the most prevalent psychological issue that has been associated with a high global burned of diseases including long duration of time with diseases and causes up to seventy percent of the global suicide rates (Stickel, 2019). Genetic predispositions, environmental factors, and intense stressor are considered the most common anxiety causes (Wiedemann, 2015).

The concept of anxiety was defined differently by researchers and mental health institutions. The American Psychological Associations stated that anxiety is “emotions characterized by feeling of tension, worried thoughts and physical changes like increased blood pressure”. On the other hand, the Anxiety Center refer to anxiety as “a state of apprehension, uncertainty and

fear resulting from anticipation of a realistic or fantasized threatening event or situation, often impairing physical and psychological functioning” (Xi, 2020).

Throughout the time, different scientists discussed the phenomena of fear and anxiety. Number of authors believes that fear and anxiety are undistinguishable emotions while others consider them as a distinct phenomenon (Steimer, 2002). Sigmund Freud stated that fear and anxiety are unrelated emotion since fear is a response of known triggered whereas anxiety occur even with the absence of the trigger (Wolfe, 2005). In his initial theory, Freud emphasized that anxiety is an automatic biological product of undischarged tension (1894/ 1962b as cited in Wolfe, 2005). Furthermore, later, Freud came out with consciousness theory where he described anxiety as a single to the ego of a serious internal impulses which could be reflected in the external world (Klein, 2002; Wolfe, 2005). Nowadays, the phenomena of fear and anxiety is interpreted from consensus and unconsensus view in psychoanalysis as fear result from a real danger, and anxiety can be triggered by unsubstantial dangers (Wolfe, 2005).

Take into consideration that anxiety emotion is a normal human’s response toward danger, pain, harm, or other aversive stimulations, but it would turn to abnormal or maladaptive if its intensity is exaggerated comparing to the danger’s potential, or when it remains with the absence of a known danger (Cloninger, 1988). In fact, long-term of anxiety can causes physical and mental dysfunctions (Xi, 2020). Xi considered a massive feeling of anxiety declines people’s ability to cope with life.

In 1966, Spielberger demonstrated the conceptual of anxiety into state anxiety and trait anxiety (Endler & Kocovski, 2001). State anxiety refers to a transitory emotion determined by physiological arousal and consciously perceived feelings of apprehension, dread, and tension (Endler & Kocovski, 2001). On the other hand, trait anxiety is related to strong stable tendency in the personality to experience anxiety (Gidron, 2013). Moreover, trait anxiety includes