PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC

RESEARCH UNIVERSITY OF IBN KHALDOUN - TIARET

FACULTY OF LETTERS AND LANGUAGES

DEPARTMENT OF FOREIGN LANGUAGES

SECTION OF ENGLISH

The role of Working Memory and Selective Attention on Language Learning and Comprehension. Case study: A1 level learners at private institutes at Tiaret.

Dissertation submitted to the department of Letters and Languages – English section for the degree of Master LMD in linguistics of English Language

Submitted by

Miss. Hala Bouhedadja

Supervised by

Dr. Lakhdar Toumi Asma

Board of examiners

Chairman	*Dr. Ammar Benabed*	*MCA*	*University of Ibn Khaldoun*
Supervisor	*Dr. Lakhdar Toumi Asma*	*MCA*	*University of Ibn Khaldoun*
Examiner	*Dr. Naima Sahli*	*MCA*	*University of Ibn Khaldoun*
Examiner	*Dr. Louiza Beleid*	*MCB*	*University of Ibn Khaldoun*

Academic Year: 2021/2022

Declaration

I declare that the main text of the dissertation is entirely my own work. This dissertation is an original report of my research, has been written by me and has not been previously submitted for the award of degree at Ibn Khaldoun University – Tiaret or any other institute of higher education.

The experimental work is almost entirely my own work; the collaborative contributions have been indicated clearly and acknowledged.

Tiaret 19th June, 2022

Miss Hala Bouhedadja

Acknowledgment

I thank Allah the Almighty who is the most beneficent and the most merciful, whose blessings are abundant and favors are unlimited - for giving us the health and the will to begin and end this humble work.

الحمد لله

I extend my deep sense of gratitude and sincere thanks to my supervisor Dr. Lakhdar Toumi Asma for her patience, support, exceptional supervision and constant assistance during all this investigative study.

I am deeply indebted to Dr. Ali Berrabah who without his help, insightful suggestions and unconditional support and patience, this research would not have been successfully conducted.

Many thanks go to all my former and everlasting teachers during my university years who endeavor to bring their best, sharing their knowledge and expertise without moderation during all the academic years. Thanks for being such inspiring people.

I would like also to express my acknowledgment to the examiners and members of the jury for having devoted some of their time and accepted to read and evaluate my work. Your advices will certainly help me make it better.

Dedication

This humble work was the result of sleepless nights and endless moments of hands shaking, to all the scattered papers above my desk I will miss you.

I dedicate this work to my safe heaven, my parents Khaled and Samira. I hope this makes you proud.

To my source of happiness, Amani, Marwa, Assia, Sana. You are the sisters I would not trade for the world.

To the pure innocent love my brothers, Abderahmane & rafaa.

To my Always, Nabil.

To the pure beautiful soul Sakou.

To those who have been there since the beginning, Tamany, Nawel, Nabila; we did it Darlings

To the unstoppable support and love, Randy.

This work is dedicated to making dreams a reality.

Hala Bouhedadja

Abstract

Language has been considerably dealt with in the field of cognitive psychology. The learning of a foreign language varies from other types of learning since it involves a complex interaction of cognitive factors. Intensive studies have been conducted to investigate the Working memory as an essential component in cognitive tasks giving that it enables individuals to hold, manipulate and retrieve information. Selective Attention, the ability to filter the inputs in the human brain is assumed an effective factor, as is working memory. To go beyond this and further explore the issue of whether the language learning and comprehension are limited by the proficiency level or by the capacity of these factors; this quantitative correlational study is planned to establish whether a relationship exists between working memory and selective attention. Above and beyond, this study paid more attention to underline the effect and role of both variables on language processing, viewing that learning a foreign language is an active process. Results indicate that working memory and selective attention are positively associated and that learning happens to rely on the capacity and the ability of both where they play an essential part in the processing and the comprehending of foreign language. The present research opened doors for several studies to be explored in the future. It is an attempt to revive the use of technology in language learning and computer based abilities/capacities testing techniques.

Key words: Working Memory, Selective Attention, Language processing, foreign language learning, cognitive functions, cognitive psychology.

LIST OF ABREVIATIONS

WM	**working memory**
WMC	**working memory capacity**
VWM	**visual working memory**
SA	**selective attention**
ASA	**auditory selective attention**
SAC	**selective attention capacity**
DLT	**dichotic listening task**
RSPAN	**reading span**
WS	**word span**
LST	**letter sequencing task**
WMT	**working memory test**
WMS	**Wechsler memory scale**
WAIS-IV	**Wechsler Adult Intelligence Scale IV**
FDS	**forward degit span**
BDS	**backward digit span**
LOP	**levels of processing model**
PL	**phonological loop**
CE	**central executive**
VSS	**visuo-spatial sketchpad**
EB	**episodic buffer**

List of Tables

List of Figures

Content

General

Introduction

General Introduction

1. **Motivation**
2. **Problem statement**
3. **Research questions**
4. **Research Hypotheses**
5. **Methodology**
6. **Research design**
7. **Aim of the study**

General Introduction

The introduction of Working Memory as a distinct type of cognitive functions eventually led to even more memory related fields including language learning in cognitive psychology. Considering that learning a foreign language implies committing the information to memory, holding and retrieving it later; indicates that language process is deeply based on working memory. In light of the fact that theories of Working Memory have a high dependency on Attention and unless the human brain is derived toward a specific item of task, the working memory will not have access to it; the presumption of the two functions being related emerged.

The history of Cognitive Psychology pictured the switch from trying to define and prove the existence of working memory as a type of memory that holds a specific area in the human brain, to questions about how the working memory capacity is measures and assessed in experimental studies. Working Memory based on recent research evidence is thought to be one of the most studied executive functions of the brain. It refers to the cognitive ability to hold a piece of information and process it for a short period of time along with the ability to retain it. Theories and models guide our view of WM from the very first arrival of the term working memory (Newell & Simon 1956) to the latest model suggested by the scientist and psychologist Alan Baddeley (2000).

The fact that language related tasks require the activation of more than one area in the brain and furthermore the manipulation of information, working memory was believed to be an effective factor for acquiring and understanding a foreign language.

Selective attention is the second hypothesized factor of language perception. The pursuit of selecting what to focus on and process when exposed to discrete number of stimuli is what best illustrate Selective Attention. Similar to working memory, SA was examined

through several models and theories elated to it ever since the first appearance of the term to the latest view (Treisman, 1964).

Considering the notable effect of the previously mentioned functions on language learning, and the issue of what type of a relationship connect them, the present study attempts to highlight the main role of both working memory and selective attention on the field of foreign language processing and the existence of a linking relation between both.

1. Motivation

As a key part of the human nature, learning depends on billions of neurons and interconnections varying in different areas of the brain. The dialogue between linguistics and psychology led to the focus on the way languages are produced and processed. In this research, we aimed to investigate some of the mechanisms underlying the production and comprehension of language alongside with how the perception of knowledge is shaped through mental activities.

Another aspect that distinguishes our study from others is that we tested our procedures in a pre-test study to ensure the reliability of the measures. One of the administered instruments is uniquely originally created for this investigation (Working memory Test in a form of a website) which is considered a huge addition to the field of cognitive psychology to have a new online test for the assessment of working memory capacity.

2. Problem Statement

While both working memory and selective attention were studied separately, it is generally remarkable that information processing is achieved mainly through paying attention. Moreover, studies have demonstrated the role of cognitive functions' capacities in language

proficiency level. Based on the previous stated view, this study examines the existence of a correlation between working memory and selective attention through the following question:

- Is there a statistical significant correlation between working memory and selective attention?

Additionally, it evaluates the role of both of the executive functions on the perception, learning and understanding of foreign languages. The foreign language in the current study is "English". The question guiding the evaluation is:

- To what extent working memory and selective attention, effect language learning and comprehension.

Research Questions

- **Is there a statistical significant correlation between Working Memory and Selective Attention?**
- **To what extent working memory and selective attention, effect Language Learning and Comprehension?**

In an effort to answer the research questions and confirm the previously suggested theories, the following hypotheses were suggested.

Research Hypotheses

1) **- Yes, there is a statistical significant correlation between Working Memory and Selective Attention.**

   - No, there is no significant correlation between Working Memory and Selective Attention.

2) **- Both of WM and SA play a crucial role in Language Processing.**

5. Research Aim and Objectives

The primary aim of this quantitative correlational study is to testify whether a correlation exists between Working Memory (WM) and Selective Attention (SA) for A1 level learners at private institutes in Tiaret. It attempts in addition to the aforementioned purpose to investigate the role of these latters on language learning.

The working memory capacity (WMC) has been considerably tested and measure using different standardized tasks such as: The Wechsler Memory Scale (WMS), The Continuous Performance Test (CPT), The Visual Organization Task (VOT) and many others. The purpose of this work is to switch from the use of numbers and purely mathematical stimuli and items to recall, to the use of letters, words and sentences in order to measure its capacity in relation with language proficiency.

In other words, the aim behind this word is to discuss the relevance of working memory and selective attention in Foreign Language Learning, as well as make use of the data that will serve as a functional, applicable tool for language and psychology future researches.

6. Methodology

The sample of population in this study was A1 level learners from three different private institutes at Tiaret. A mixed-method was used for data collection process, through both quantitative and qualitative methods.

The methodology included five distinct tests, which varied from original ones to modified test to fit the Algerian Socio-cultural context. The tests for measuring working memory capacity were the reading span (RSPAN) and the online test using the website, which included two subtests: the Letter Sequencing Task (LST) and the Word Span test (WS).

The Selective Attention ability was measured using the Dichotic Listening Task (DLT), which consists of two subtests (DLT 1 & DLT 2).

7. Research Design

This research paper is a combination of three chapters, the first chapter provides a theoretical overview of the different hypothesized variables of Language Learning and Comprehension. The second chapter introduces different measurements and the history of both working memory and selective attention tests, along with the data collection procedures. The research concludes with the third and last chapter revealing the findings, discussions and data analysis procedures.

The last part deals with the research limitations, recommendations and some suggestions for future researches.

Chapter 1: Working Memory, Selective Attention and Language Learning

Chapter One

Working Memory, Selective Attention and Language Learning

1.7. Introduction

1.8. Working Memory

1.8.1. Historical Background

1.8.2. Working Memory Models

1.8.2.1. Atkinson & Shiffrin Model

1.8.2.1.1. Memory Systems

d. Sensory Memory

e. Short term Memory

f. Long term Memory

1.8.2.1.2. Critics of the Modal Model

1.8.2.2. Craik & Lockhart Model

1.8.2.2.1. Critics of the Levels of Processing Model

1.8.2.3. Baddeley & Hitch Model

1.8.2.3.1. Working Memory Components

d. The Phonological loop

e. The Visio spatial Sketchpad

Working Memory, Selective Attention and Language Learning

1.1. Introduction

Cognitive factors that drive the knowledge of a language possessed by a speaker do vary significantly across individuals, and researchers were interested and still in real-world types of functions as well as Language Learning. Whenever anything is needed to be learned, Working Memory (WM) is required since the process of learning demands manipulation of information, interaction with long-term memory, and simultaneous storage and retaining of information. It is considered one of the most influential topics discussed in Cognitive Neurosciences. Although Working Memory appears corely in most of Language Learning and Comprehension theories, it is generally remarkable that it has a high dependency on Attention. Working memory's correlation with attention is a critical part of a person's cognitive capabilities. To demonstrate a better understanding of the effects that Working Memory and Selective Attention (SA) have on Language Processing and what kind of a relationship they share; this chapter will seek to present the definition, historical background, and capacity measuring along with major models of both W.M and S.A, in addition to their effect on Language Learning.

1.2. Working Memory

There has been a long-standing history on the concept of Memory. To begin with, researchers from different fields used the term *"working memory"* in various contexts; it has come to be used in cognitive psychology to refer to the system or mechanism underlying the maintenance of task-relevant information during the performance of a cognitive task (Beddeley & Hitch, 1974; Daneman & Carpenter, 1980). From the earliest mention in Computer Sciences,

it was used to refer to the structure responsible for holding the information temporarily such as solving geometric proofs (Newell & Simon, 1956).

Baddeley (2000, p. 418) defined working memory (WM) as “a limited capacity system allowing the temporary storage, and manipulation of information necessary for such complex tasks as comprehension, learning and reasoning”. In his notion, Baddeley heavily focused on two main issues: the limited capacity of the system, which was ever since the beginning of the research of working memory a topic of huge importance. Moreover, the active nature of the procedure rooting from the ability to hold and manipulate an amount of information in mind in an active, readily available state for a while. In other words, it is the type of memory that manipulates data rapidly to perform everyday tasks such as learning and reasoning (Ferreira et al, 2015. P. 1582).

1.2.1 Historical Background

To our knowledge, the earliest mention of the term Working Memory originated not from the study of the Human Brain, but from that of Computer Sciences. The term was used to refer to the structure responsible of holding the information temporarily such as solving geometric proofs (Newell & Simon, 1956). The Logic Theorist is a “thinking machine” invented sixty-six years ago. It is a computer program written in 1956 by Allen Newell and Herbert A. Simon which was referred to as "the first artificial intelligence program" since it was probably the first working program that simulated some aspects of peoples' ability to solve complex problems and perform tasks. As it was the first software designed specifically to do automated reasoning, it was somehow built to mimic the human brain’s functions. The ideas about mental representation and problem solving included in The Logic Theorist are of a central importance in Cognitive Psychology and scientists believe it has a large impact on the recently developing subject of information-processing.

In the context of theories that linked between the mind and computer, Atkinson and Shiffrin (1968) used the term "working memory" after it was coined in 1960 by Miller, Galanter and Pribram in their classic book *"Plans and the Structure of Behaviour".* Their model proposed that in order to retrieve information, one has to look for the correct trace of it and how it was stored in the brain. The model of Atkinson & Shiffrin (1968) was the first at that time as Baddeley mentionned in his book until Craik & Lockhart in 1970 came up with a framework named levels of processing (Baddeley, 1983, P.313). Later in a work that followed, it faced criticism and enhancement.

In view of the fact that there was still questions concerning the notion of working memory unanswered, the work of Baddeley & Hitch 1974 named the "multiple component model" presented the working memory construct and called attention to its components and how significant is its influence on cognitive learning and performance.

Scientists were motivated by the need to develop a body of theories that could be used to define and explain how it works. We will discover the main theories concerning the notion of Working Memory and compare them. The models will be discussed clearly in a chronological order.

1.2.2. Working Memory Models

1.2.2.1. Atkinson & Shiffrin's Model

Short term store (STS) and long term store (LTS) were the two fundamental stores in this approach. There is a broad agreement that the idea of Short-term (S.T) and long-term (L.T) memory being distinct was first introduced by Richard Atkinson & Richard Shiffrin in 1968.

Atkinson & Shiffrin model named also the "Multi Store model" was seen more as an information processing model since they claimed that the information enters the Sensory

Memory (S.M) via consciousness while being observed or paid attention to then transferred to short term store to be encoded in the long term store where control processes are applied for storage and retrieval.

Between the S.T.S and the L.T.S, scientists defined three major processes: encoding, storage, and retrieval. Each one of these mental processes involves a variety of other processes. Encoding is presented as the first information storage step, which relates to putting the information in the (STS). After encoding, rehearsal takes place referring to the process of maintaining information in the STS until it moves to the LTS (Mc load, 2007). The information transference into other codes in the STS is presented through the "Decoding" step, which leads to the final process Retrieval defined as remembering the information or events that were previously encoded and stored in the brain.

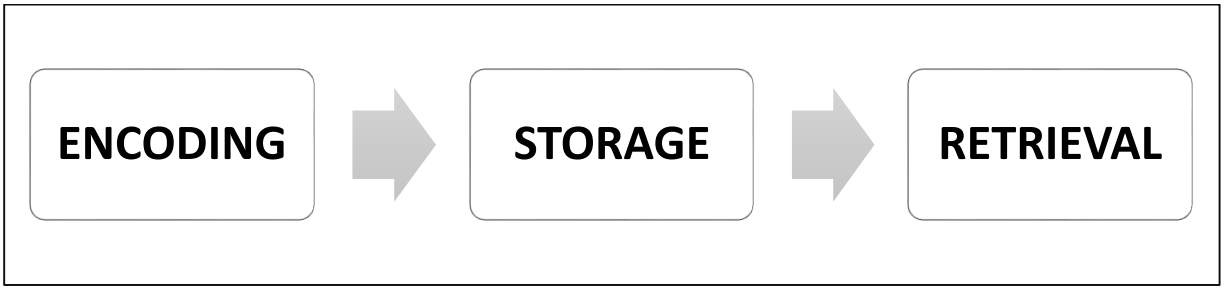

Figure 1.1 the Three major information processes (based on Atkinson & Shiffrin's model 1968)

For the Atkinson and Shiffrin theory (1968), the word "transfer" is fundamental. It describes the process of shifting data from one store to another while preserving the original component unaffected.

1.2.2.1.1. Memory systems/stores

The model of information processing (1968) accentuated that there are three distinct systems of memory: sensory memory, short-term memory and long-term memory. Every component will be explained briefly in the following section.

a. Sensory Memory (SM)

In the Atkinson & Shiffrin model, stimuli from the environment are processed first in sensory memory that is the storage of brief sensory events; such as sights, sounds, and tastes when being aware of. It is the primary stage of perceiving information and a crucial step for processing it since there is no possibility of transferring information to different stores without being perceived in the sensory memory or sensory register as referred to by some researchers. If the information in this store/stage is not passed to the next stage it will be exposed to rapid decay. Its duration lasts between 1/5 and 1/2 seconds and can hold 12 items.

Sensory register as a separate store contains different "sensory dimensions" that register instantly the stimulus. For instance, when an individual is faced with a set of numbers or letters, a visual image is formed in the register and transferred to auditory verbal linguistic STS (avl STS) rather than being transferred to visual STS. The reason behind that is that the visual STS lacks the rehearsal strategy. In this system, control processes select the information that should transfer to STS.

b. Short term Store (STS)

In Atkinson and Shiffrin's information processing model, this component was presented second. It is called also short-term memory. Both "sensory register" and LTS provide input to the short-term storage. However, the information is lost quickly, after 30 seconds at most (it

takes a little longer than the sensory register). The auditory verbal linguistic (avl) storage is estimated to contain information for 15 to 30 seconds. Atkinson and Shiffrin (1968) claimed that information in this store is exposed to a complete decay. In order to prevent the stimulus from decay, control processes such as; grouping, organizing and chunking are examples of what the short-term store would use to keep the information until it will transfer to the LTS.

c. Long term Store (LTS)

The Long term Store is presented as the permanent store that holds information coming from the STS for approximately indefinite period. It is also called the Long term Memory in which the information is not exposed to decay unless the brain is damaged or injured. It can be either linked to sensory systems such as memory of tastes and smells; or it is totally separate like memory of knowledge about something like words and semantic memory.

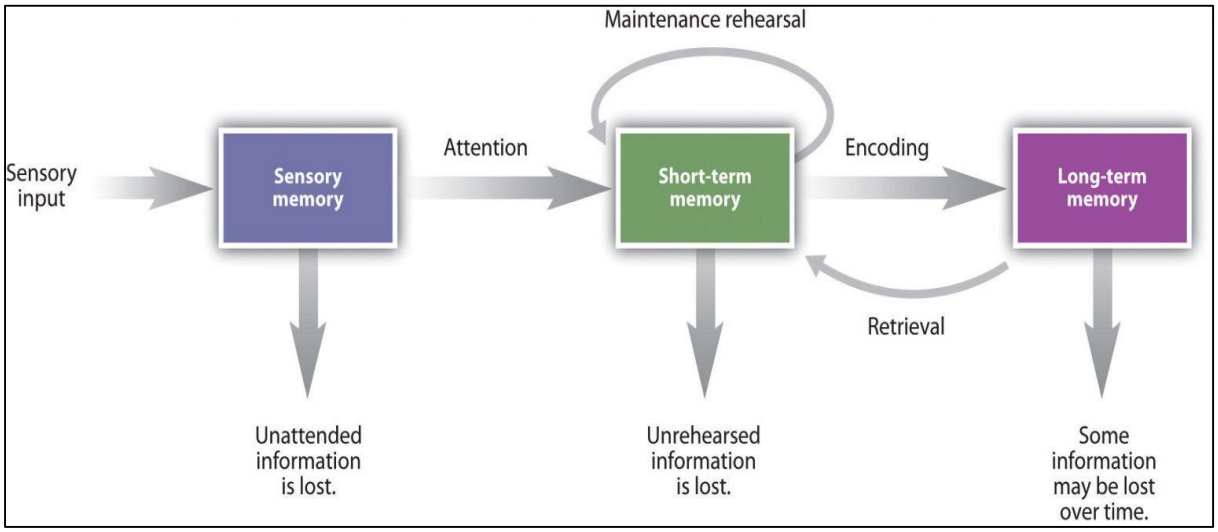

Figure 1.2 Atkinson & Shiffrin multi-store model (1968) from simplypsychology.org

1.2.2.1.2. Critics of the Two-store model

Atkinson and Shiffrin Two-store Model of information processing received a wide popularity for highlighting two separate stores in the memory system. However, it faced various critics since the model advocates information is processed in a linear way. Therefore, a deficit or a damage in one system would lead to an impairment in another, which is not the case in the study of Shallice & Warrington (1970) that reported a patient with deficit of short-term memory but also had no impaired long-term memory (Baddeley, 1983, p. 313). Additionally, "rehearsal" is considered a simple way to transfer information from STM to LTM ignoring the existence of other ways such as semantic processing which was mentioned in the study of Craik & Watkins (1973); and factors including motivation, effect and strategy (e.g. mnemonics [1]) which underpin the process of learning. Rehearsal was contended to be essential to transfer the stimulus to LTM even when we can take the example of being able to recall information, which we did not rehearse (e.g. swimming); yet unable to recall information which we have rehearsed (e.g. reading your notes while revising). As a result, the importance of rehearsal in shifting from STM to LTM is significantly less important than what Atkinson & Shiffrin (1968) claimed in their model.

The outcome of these problems within the multi-store model was the start of other studies and the emergence of different theories.

1.2.2.2. Craik & Lockhart Model

In 1972, Robert S. Lockhart and Fergus I. M.Craik proposed a new model of memory formation related to *"depth of processing".* The main difference between this model and the framework of Atkinson & Shiffrin is that the Information processing model involved stages; and the levels of processing model involved a hierarchy. Craik & Lockhart proposed that the

[1] Mnemonic is a system such as a pattern or letters, ideas, or associations, which assist in remembering something.

information does not go through stages of storing, whereas it is the fact of how deep it is processed and the deeper information is processed, the more likely it is to be remembered.

In other words, they claimed that the information is easier to transfer to long-term memory (LTM) when it can be related to other memories or information the individual is familiar with. As an illustration, if an individual wants to remember a piece of information, he/she should think about it more deeply and link it to other information, events and memories to make it more meaningful. Craik & Lockhart theorized that not all sensory information are processed the same and therefore are transferred to our LTS at different rates. That is to say, information that requires cognitive processing (deeper processing) will be more likely remembered than information requiring shallow processing.

According to levels of processing (LOP) model, there are three levels at which information can be processed. In order from shallowest to deepest, they are:

a. **Structural Level:** the physical characteristics of sensory information (e.g. shape, color, size).
b. **Phonological Level:** the sounds of information;
c. **Semantic Level:** the meaning of the information processed.

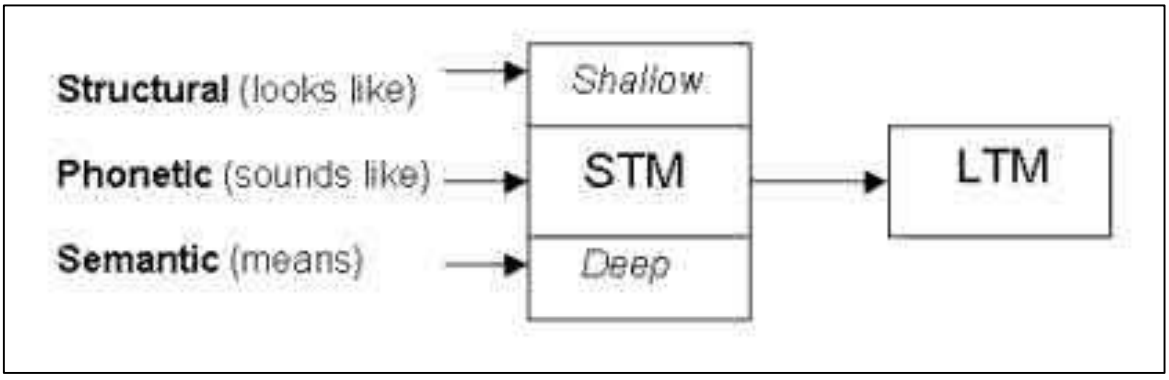

Figure 1.3 Levels of processing (McLeod, S. A., 2007, December 14)

Craik & Tulving in 1975 conducted a key study to investigate how deep and shallow processing affects memory recall. The method focused on showing participants a series of 60 words; some questions required the participants to process the words in a deep way (e.g. Semantic) and others in a shallow way (e.g. Structural and Phonemic). Moving to the results, participants recalled more words that were semantically processed and compared to phonemically and visually processed words. This leads to a conclusion that says, "Semantically processed words involve elaboration rehearsal and deep processing which results in more accurate recall; while others lead to less accurate recall" (Saul McLeod, 2007).

The theory of Craik and Lockhart was an improvement on Atkinson & Shiffrin's and led to hundreds of experiments most of them confirmed the central effect of deep processing in remembering information.

1.2.2.2.1. Critics of the Level of Processing model

Despite the strengths of (LOP) model, it forced criticism on how it does not explain how the deeper processing results in better memorization. In addition to the fact that deeper processing takes more efforts and it could be what makes it more likely for people to remember.

Eysenck (1990) suggested that (LOP) describes than explains since they failed to provide a detailed account of why deep processing is so effective. Craik defined depth as: "the meaningfulness extracted from the stimulus rather than in terms of the number of analyses performed upon it." (1973, p. 48) from his definition, Eysenck (1990) stated that the idea of depth is vague and difficult to measure, this can lead to an argument about to what extent it is important to measure how deep information are processed? Moreover, is it the key to retention? (Mc Leod, 2007).

1.2.2.3. Baddeley and Hitch Model

Researches in the field of memory led to closer understanding of the concept and differentiation between STM and LTM. However, they did not stress the functional part of it. Alan Baddeley & Graham Hitch in 1974 came up with a working memory model named the Multicomponent Model.

Baddeley & Hitch (1974) replaced the concept of "short term memory" by "working memory" perceiving this latter as a central process functioning in complex cognitive behavior such as learning, reasoning and comprehension. This process involves storing, manipulation of information and attention. (Baddeley, 2003a) Unlike the short term memory that holds limited amounts of information for short periods of time with relatively little processing; the working memory manipulate the information and it is a multi-component system (auditory, and visual).

This theory defined working memory as "a limited capacity processing and storage system that is necessary for carrying out a wide range of tasks" (Baddeley, 2003 as cited in Guo, 2016, p. 1820). It proposed that working memory is like a multi-part system, and each system is responsible for a different function. They attempted to divide working memory into three parts: the phonological loop, the visuospatial sketchpad, and the central executive, which will be explained separately below.

1.2.2.3.1. Working Memory components

Baddeley (1974) argued that the system of working memory is composed of different sub-systems named components or parts. The concept of working memory is similar to that of STM. However, instead of all information going into one single store, there are different systems for different types of information; and unlike short-term memory, it can both retain and process stimulus.

a. The phonological loop

The phonological loop is a component of the working memory due to the Multi-component model, which comprises of two sub-components, a storage sub-system called the phonological store and a maintenance component known as the articulatory rehearsal process. Before decaying, the phonological storage may keep speech-based information for a short time (about 2 seconds per item). The purpose of the articulatory rehearsal process is to prevent this loss of information by "refreshing" the contents of the phonological storage with sub vocal speech on a regular basis.

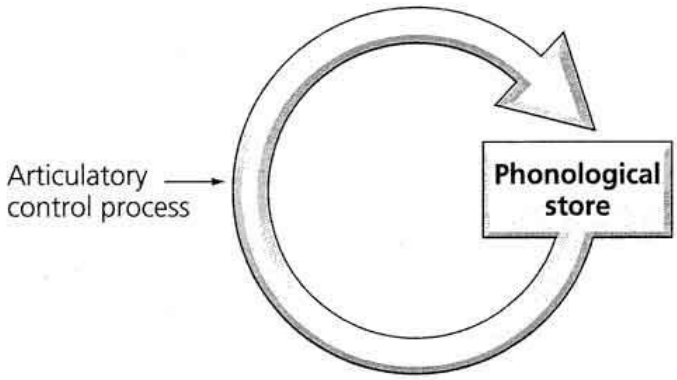

Figure 1.4 the Phonological Loop (Baddeley, 1974)

b. The visuospatial sketchpad

While the processing of verbal information is the responsibility of the phonological loop, this component (Sketchpad) stores and manipulates visual and spatial data. The visuospatial sketchpad refers to our ability temporarily to hold visual and spatial information, such as the location of a parked car, or the route from home to a grocery store.

The visuospatial sketchpad also allows us to recreate images based either on something we are seeing in real time or on something we've seen in the past such as the shape of a fruit.

c. The central executive

The central executive is the most important but the least empirically studied and explained subsystem. It is defined as "the ability to focus, to divide and to switch attention and the ability to relate the content of working memory to long-term-memory" (Baddeley and Repovs, 2006, p. 13). Despite its remarkable importance, it lacks information concerning its functions. The central executive component of the working memory plays the role of a controller; it directs attention and retrieves memories.

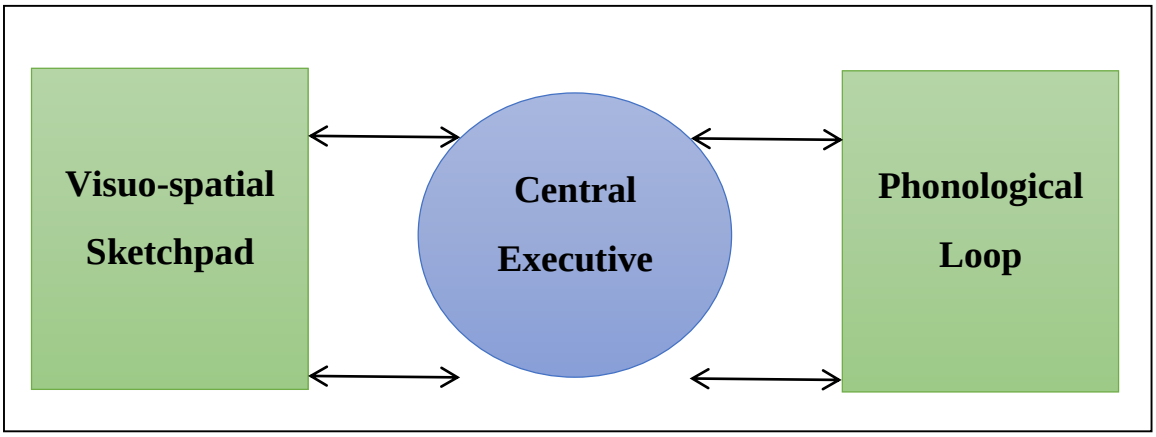

Figure 1.5 the Initial Model of WM, Baddeley and Hitch (1974) (in Baddeley, 2000, p. 418)

d. The Episodic Buffer

Viewing that the Multicomponent model was integrated in different fields, Baddeley (2000) came up with a new recent model with major changes in which he introduced a new

component named “The Episodic Buffer”. Previously when the new model was not created yet, the “central executive” was assumed to be responsible for both “storage and attention”; however, after three decades later the episodic buffer appeared to be principally concerned with the storage process, allocating the control of attention to the central executive.

The term “episodic” originates from the function of the component, considering that it takes episodes of information and extends them over time, and transfers information from/to LTM and relates it to WM. (Baddeley, 2000)

The Episodic Buffer is a temporary store for information which brings together data from other sub-systems.

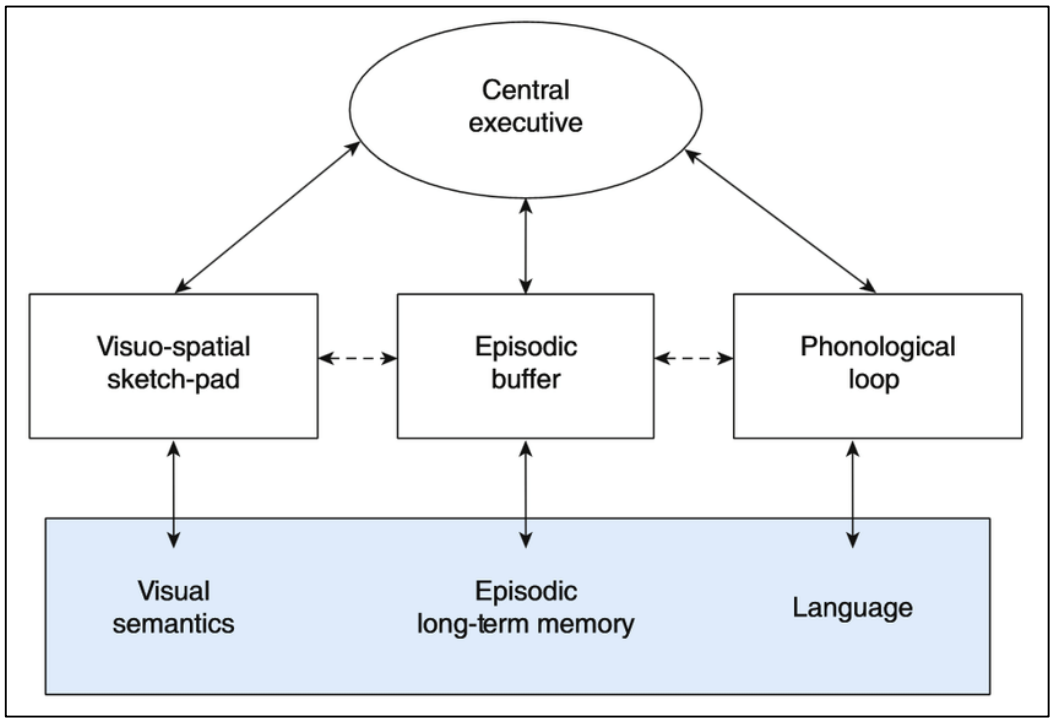

Figure 1.6 the revised Model of Working Memory (Baddeley, 2000) Source: Henry, (2012)

1.2.2.3.2. Critics of the Multicomponent model

Despite the fact that Baddeley and Hitch model has made a great deal of progress in the field of cognitive psychology and was regarded as a landmark for memory studies; however the model was criticized due to the lack of explanation of the functions of the stores and how unclear what the central executive is. Lieberman (1980) stated that the visuospatial sketchpad (VSS) implies that all spatial information was first visual which was why he criticized the multicomponent model based on the results from his experiment, which shows that even blind people have remarkable visuospatial awareness despite the fact that they never experienced any visual knowledge.

1.2.3. Working memory capacity

Numerous tasks have been used over the years to measure working memory capacity. Although all of the tasks and tests work in the sense that the performance on them reflect the level of skill in processing which determine the storage capacity. However, the problem of WMC still is a huge field of interest for researchers and an unanswered question.

The American psychologist William James (1890) claimed that working memory capacity is divided into two types: "Primary memory" (close to S.T.M) and "secondary memory" (close to L.T.M). From his notion, Miller's view of working memory capacity was inspired. In 1956, "The magical number seven, plus or minus two: some limits on our capacity for processing information"; a paper published by George Miller in which he hypothesized that short-term memory can store between five and nine items. The storage may be in single units named "bits" or in the "grouping" method known as "chunks"[2]. This latter enables us to hold

[2] A chunk is the unit the memory can hold and manipulate. It originates from the method "chunking" which refers to the process of taking individual pieces of information and grouping them into larger units in order to improve the amount of processed stimuli.

more stimulus and manipulate it. A chunk is defined as "a collection of concepts that have strong associations to one another and much weaker associations to other chunks concurrently in use" (Cowan, 2000, p.89).

In his article: "the magical number 4 in short-item memory: A reconsideration of mental storage capacity", followed by his famous book "Working Memory Capacity" (2000), Nelson Cowan came with a different standpoint. According to him, the best memory performance is present when the brain does not have to recall more than 4 items, and that was the moment when the Miller's magical number (7) was replaced by Cowan's number 4 (±1).

It has been an issue to shape and measure W.M capacity considering that the working memory consists of multiple mechanisms and systems; and that it may be affected by the length of items to be memorized and retained.

1.3. Selective Attention

Countless number of tasks from daily life rely on cognitive processes such as "Attention" which allows us to direct our awareness towards specific stimuli and react to them.

Attentional behavior vary from: paying attention for long periods of time to keep ourselves away from distraction, to carrying out all of the necessary information and knowledge. However, they all possess a huge importance and a central role in guiding our awareness and focus on a particular aspect among many others. Almost without exception, researchers have recognized the existence of a selective central factor, which resulted in decades of research to present the term "Selective Attention".

1.3.1. Historical background

Cognitive psychologists contended that we are constantly surrounded by an endless number of stimuli, and the fact that the human brain is actually able to select, process and respond to a specific item, message or problem was the origination of a selective factor, which was named later Selective Attention (SA). Scientists recently developed a body of literature concerning the concept of S.A including the bottleneck models.

1.3.2. The Bottleneck models (Selective Attention's models)

1.3.2.1. Broadbent's model (The Filter Model)

The filter model of attention proposed by Donald Broadbent in 1956; revealed a "sensory buffer" through which all sensory information burst into memory, thereafter a single stimulus is filtered in and the others are rejected. As long as, every stimulus has physical properties such as "color, sound, direction, shape, category…etc."; the selective factor filters information based on these properties for further processing. Broadbent stated that "individuals have a limited amount of attentional resources that they can use at one time; hence, the knowledge is filtered to help perceive only what is important" (1958).

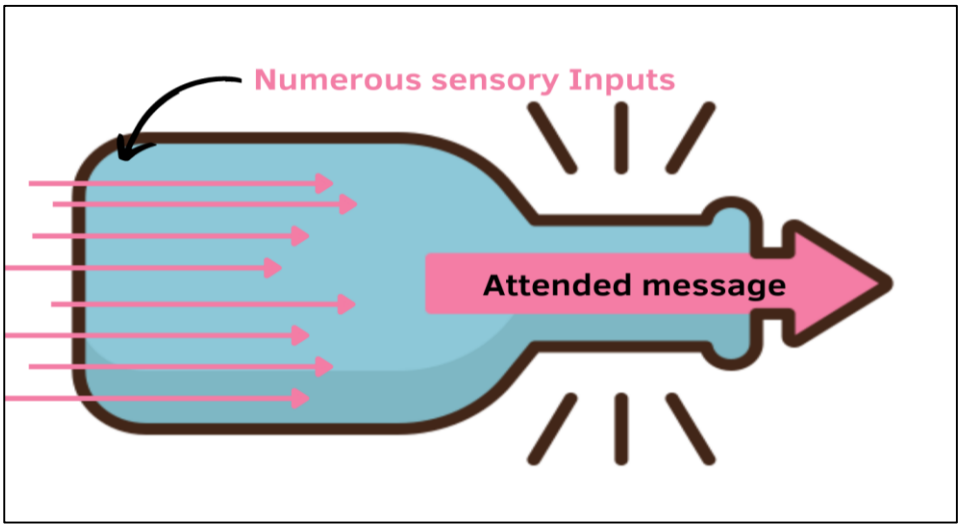

Figure 1.7 the Bottleneck Filter Model of Selective Attention

In his experiment, Broadbent (1956) aimed at investigating how people were able to focus their attention. He achieved it through sending one message to a person's right ear and a different message to the left ear. The examination was called the "dichotic listening span".

The Dichotic Listening Task: it is a test created in the field of psychology to investigate selective attention and the brain function while being exposed to different stimuli. We will explain it in details in the second chapter within the SA tests. (C.f. chapter 2.6.2)

1.3.2.2 Critics of the filter theory

During the experiment of Broadbent, the participants were receiving information with shadowing tasks [3]. Therefore, they found it very difficult and demanding, which led to criticizing the theory of Broadbent. In addition to the fact that if we follow what the model stated it will be impossible for a person to hear his/her name when not paying attention, as long

[3] A type of cognitive testing in which the participant repeats aloud the message word by word at the same time that the message is being presented.

as the unattended messages are filtered out. The mentioned critics of the filter model of attention and many others gave on to the foundation of the attention model, which will be discussed next.

1.3.2.3. The Attenuation Model

Ann Treisman (1964) suggested in her version of the filter theory of attention that the unattended messages are attenuated (weakly processed) instead of entirely blocked and rejected. This model is seen as a revision of Donald Broadbent's filter model, except that this latter took into consideration the messages filtered out stating that they are not eliminated from our consciousness. The point of how it is impossible to attend to all sensory input at once is an agreement between the models of S.A.

Selective Attention is the new suggested term meaning "…turning down the volume to concentrate, so that if you have 4 sources of sound in one room (TV, radio, people talking, people crying) you can turn down or attenuate 3 in order to attend the fourth" (Mc Leod, 2018)

The theory of Treisman (Attenuation Filter Model) manifested that all participants were able to recognize the content of the unattended messages; taking into account that they were able only to recall the physical characteristics of the message and not the meaning, which means the unattended input's meaning was not processed or focused on.

1.3.2.4. Critics of the Treisman Model:

The model of Treisman although it brought a lot into the field of attention studies and elevated the way Selective Attention was seen before, it received critics on how the process of attention has never been precisely specified and explained. Moreover, it neglected the semantic analysis of the input and how it works.

1.4. Working Memory and Selective Attention

The relationship working memory shares with attention is a part of an individual's cognitive capacity: allowing an individual to actively process information, retain task-relevant information, and simultaneously manipulate that information (Allaway et al, 2010; Brox et al, 2012; Fougnie, 2008).

The capacity to perform some complex tasks depends critically on the ability to retain task-relevant information in an accessible state over time (working memory) and to process selectively information in the environment (attention).

For the purpose of proving the existence of this relationship, the current study investigate the two variables in multiple experiment (c.f. chapter 3.6).

1.5. Memory, Attention and language learning

1.5.1. Definition of language

Linguists highlighted a set of definitions for what language really is. They identified several components, factors, characteristics and aspects to it. According to Oxford's definition: "Language is the system of communication in speech and writing that is used by people of a particular country or area".

Language perception is not primarily about individuals identifying the given information/stimulus; it is about how the brain uses combined sources of knowledge (auditory, visual …) and recognizes them. Studying the mental processes that transform the information in the speech into linguistic meaning has been for a long time an interesting field of study in psycholinguistics. The cognitive neuroscience had a remarkable impact on the filed over the last decades.

The early Behaviorist psychological tradition was concerned with the concept of behavior within humans and animals. One of the main discussed topics was the leaning process through stimulus and reinforcement by the American famous psychologist Skinner in 1950. It represented reinforcement as a major central factor in shaping both behavior and language. They sought Memory as a pure set of relationships between stimuli and response. However, the appearance of cognitive psychology in the late nineteen fifties shaped the process of learning in a complete different way. The focus shifted from the individuals' behavior and thinking processes into the brain function and the language being a Brain's function. They started using behavior as a tool to assess the mechanisms, systems and functions of the brain. Miller (1956) was the first to introduce the different functions of the brain, and explained how language is initially the production of knowledge in different areas in the brain.

A great many scientists set the basis for the cognitive psychology studies in relation to the language. Namely, Eysenck & Keane (1995); Miller presenting his paper about the magic number seven (1956); and Chomsky with his preliminary paper on his famous theory of language (1965). Chomsky's contribution suggested language as a unique human attribute, autonomous cognitive ability and an innate ability.

1.5.2. Definition of learning:

The process of acquiring and understanding knowledge or an ability is referred to as learning (Merriam-Webster, 2019). From a psychological opinion, learning is defined as a relatively permanent change in behavior or a result of experience.

Moving to a generative linguistic standpoint, the American linguist Noam Chomsky (1960) introduced the Traditional Generative School and claimed the existence of T.G.G[4] for all languages; he criticized the surface structure and shifted attention to deep surface of meaning. This point influenced the cognitive psychologist to direct the focus toward different cognitive factors effecting language learning such as working memory and selective attention. Many researchers centered the role of these latters in the process of learning a foreign language.

The role of working memory and selective attention in second language learning and comprehension is investigated in the current research to confirm the aforementioned theories and views.

1.6. Conclusion:

In order to perform complex tasks from our daily life and respond to them, working memory and selective attention are involved for the brain to allow active process of the information. The first chapter in this research provided interesting answers to the challenges and questions about what really is working memory and selective attention. Moreover, how both play a crucial role in language processing. Alongside, with the historical background for both. It is noticeable from reviewing literature that cognitive factors play an essential role in learning process. The next chapter will present description of the research methodology, data collection methods and tools.

[4] T.G.G stands for the Traditional Generative Grammar, a theory of Grammar that describes the language in terms of transformations applied to an underlying logical deep structure in order to generate a meaningful structure.

Chapter 2: Measuring, Instrumentation, and data collection

Chapter Two

Measuring, Instrumentation, and Data Collection

2.11. Introduction

2.12. Research Design

2.13. Sample population

2.14. Instrumentation

2.15. Working Memory measuring

2.15.1. Memory measuring tests

2.15.2. Short-term Memory measuring tests

2.15.3. Working Memory tests

2.15.3.1. The Reading Span Task

2.15.3.2. The Wechsler Adult Intelligence Scale

2.15.4. The aim of measuring Working Memory Capacity

2.15.5. Description of the WM measures

2.15.5.1. RSPAN

2.15.5.2. WMT (website)

a. First online subtest: Letter Sequencing Test

b. Second online test: Word Span

2.15.6. Procedures

2.16. Selective Attention measuring

Measuring, Instrumentation, and data collection

2.1. Introduction

In an effort to bridge the gap between the theoretical part presented in the first chapter and the practical side; this chapter will present the different tests and tasks to measure the research variables. It attempts to include a description of the research methodology, procedures, population and instruments of data collection. In addition to the aim and prescription of every measuring used tool/test. The present work used the « reading span » and a website created by the researcher. Therefore, this chapter will incorporate a report of the process of how they were created and used.

2.2. Research Design

It is noteworthy that the research design refers to the overall strategy that the researchers chose to integrate the elements of the research in a clear coherent way. It has an integral role in conducting an adequate research and obtain reliable results and conclusions. The following presented design will help overview the way the research will stick to, starting from the research problem until the analysis of the data.

It is clear that the current study is of a correlational nature, which requires the use of different types of correlation during the process of examining the research hypothesis. The first type is the one between the research variables: working memory and selective attention, which will help us, establish whether a relationship exists, and how strong it is. The correlation between the different scores of each sub-test of each measure is the second type; and it helps us to check the reliability of the measurements and how they are related to the total scores.

The collected data in the present research are primarily quantitative and it is necessary to acknowledge that the tests are not the standardized tests (such as the "Online adult Wechsler intelligence scale test", 2013; IndiaBix, 2008; Team examsbook, 2013); however, they are created based on it and modified to fit in the research's physical, social, and experimental context. Noting that the tests in general were administered according to theoretical evidence and testing standards.

A further statistical technique that was carried out in our research is the pilot test, which aimed at testing every measure and cement the measurements' process.

2.3. Instrumentation

In the terms of the establishment of the relationship between the research variables and their effect and role on the process of learning language, the researcher used three different tests to test working memory capacity (WMC) and other two tests to measure the selective attention capacity (SAC) and duration as well. The next part will address the different measurements along with their history, description and aim.

2.4. The Sample Population

To accomplish the anticipated objectives of the present study, a sample of eighty participants (80) was designed and formed into four groups of twenty (20) subject each. The participants in the current research are A1 level learners from private institutes in Tiaret. The sample is composed of both males and females. The division of the groups was their actual division by the administration. The institutes selected were three: Skyline, Rihi, and Star net. The age ranged from 16 to 25 years old with a mean of M = 22. The focus in our research was on the cognitive functions and abilities of individuals despite their language proficiency level, gender, and background experiences.

The tests were passed using the measuring tools during one day to obtain reliable, valid and identical results. A detailed description of the measurements used in this research is provided in the chapter below. (C.f. chapter 2.5.1)

2.5. Working Memory measuring

Numerous tasks and tests are often interpreted as valid measures of WM Capacity. There has been a long-standing history on the concept of WMC and assessments. Many theories exist on the nature of its capacity and the question of whether it is a unitary system (C.f chapter 1.2.3).

Since the current research-paper aims at defining the role of WM at language learning, a review of literature of how the history of measuring developed has to be introduced.

2.5.1. Memory Measuring Tests

The strong correlation between memory and intelligence forced the creation of memory tests and measuring techniques, for instance, Conway (2002) revealed a strong positive correlation between them and specially the effect of working memory on brain's activities (p. 163). The emergence of experimental psychology lined with the numerous attempts to measure human memory; the recall of complex poetry was the strategy used by Galton (1883) in his research aiming to measure memory's capacity. However, a contrasting perspective claimed that the laboratory measuring experiments are unreliable and they should be conducted in real life circumstances. This view moved the items used for measuring from nonsense words to actual English words since WM specifically and memory generally have a crucial effect on foreign language learning and comprehension.

2.5.2. Short-term Memory Capacity Measuring

In the course of STM capacity measurement, the psychologists Conway, Cowan, Bunteng, Therriaul and Minkoff (2002) came up with different tasks including “words spans” and “digit spans”. Few extra tasks like “Letter span” came up later all in order to assess the temporary storage capacity. The main goal behind all the aforementioned tasks and tests was to measure STM capacity and discover what are its limits. After Atkinson & Shiffrin’s model (1968) (c.f. Chapter 1.2.2); Working Memory was presented as a separate system from STM that opened onto the arrival of WM tests.

2.5.3. Working Memory Tests

The topic of measuring working memory in the field of cognitive psychology garnered a lot of attention and the main tests developed for that purpose were: Reading Span (RSPAN), Operation span (OSPAN), Listening span (LSPAN) and counting span (CSPAN). According to Daneman & Carpenter (1980), the term span refers to working memory capacity, for instance, someone being able to remember four to five items, is called to have a span of four or five ... Etc.

The task used in our research among those is the reading span task (RSPAN); we will consider this span and its history and content in the next part.

2.5.3.1. Reading Span Task (RSPAN):

According to the APA dictionary definition, the reading span is the amount of written or printed material that a person can apprehend during a single fixation of the eye while reading.

The reading span task is a complex span test created by Daneman & Carpenter in 1980 aiming to assess both, the storage and manipulation of information processing. Bailey (2012) named it “The verbal task” since it activates the verbal store in the human brain. After its

publishing, it was used in many studies to investigate working memory (Kraus & Breznits, 2009).

The first usage of this test was to investigate whether a correlation exists between WM and Reading comprehension, furthermore, to test the effect and role of WM on language learning process in general; As an experiment in cognitive psychology, the RSPAN is formed of four different series of sentences (from 2 to 7) handed to a number of subjects. They are instructed to read them or explore their semantic accuracy and remember the very last word of every sentence.

Example:

- "When in trouble, children always wish for an intervention by a superhero"
- "They supposed that I had other motives, besides the desire to escape the law"

The participants/examinees were asked to read aloud the sentences and recall the words that appeared at the end.

Recall: (Superhero, Law)

The participants recalled the words of every span and the maximum number of recall words decided their WMC (after a short stop). Five seconds (5s) was the time of exposure for every sentence, which is believed to be the sufficient time to read a sentence.

NB: The fact that Daneman and Carpenter's test tested WM in relation with language motivated us to include it as a method of data collection in the current research.

2.5.3.2. The Wechsler Adult Intelligence Scale (WAIS):

Along with the many complex, span tests used along the history to measure the human ability to hold an information in the brain and process it. There has been a remarkable development and noticeable effort from the part of psychologists to solve this phenomenon.

Around the 2000s, a scale named the "Wechsler adult intelligence scale" was published and since then it became a popular choice among practitioners for assessing general intelligence (Colliflower, 2013, p.01). The scale had been through several revisions until the latest update published in the fall of 2013. The WAIS-IV consist of a set of Index, where each Index includes up to three subtests to measure individuals' cognitive abilities and capacities. According to Colliflower (2013), this scale in assessing WM had a major role and an important affect.

The Working Memory Index is comprised of the Digit Span (DS) and Letter-Number Sequencing (L-NS) tests.

a. Digit Span

This task was divided to 2 parts: Digit Span Forward (DSF) and Digit Span Backward (DSB). The participants are asked to recall a series of digits (Numbers) Forward and Backward.

Example: "(5-2-3-9-12)".

- Forward: "(2-3-5-9-12)".
- Backward: "(12-9-5-3-2)".

b. Letter-Number Sequencing Task

It involves listening/reading series of letters, words, digits and reporting them back in an alphabetical, numerical order.

Example: "(B-X-V-F-C)"

- Recalling the sequence in the alphabetical order: "(B-C-F-V-X)".

Even with the questionable validity of the WAIS-IV scale and its different Indexes, it was used in different studies and researches and scientists relied on it in some theories and models. Based on what has been mentioned, and the research history of "WAIS-IV", we created a designed website named "Working Memory Test" with a goal to achieve an approximate, affective and valid test to measure WMC.

c. The webpage Working Memory Test

The website "Working Memory Test" was designed and created based on the two subtests: "Digit Span Task" and "Letter Sequencing Test", where examinees will pass two tests to measure the WMC. It was created uniquely and specifically to measure the capacity of WM in the language learning. The next part will discuss the creation of the website along with the details and different components of it. (C.f. chapter 2.5.5.2)

2.5.4. Aim of Measuring Working Memory Capacity

Being able to speak a variety of different languages or learn a foreign language (English in this research)-demands numerous cognitive functions and exploring WM as an effective element in the process of learning and understanding language is the main aim behind this investigation.

- First, The task switching and manipulation of information, along with WM as a system has been highly argued to correlate with our ability to control two languages or more as well as learning new languages. Schroeder and Marian (2012) have also presented that many early researches demonstrated that adults speaking two or more languages possess a high level of executive functioning, specifically in the areas linked to memory performance.

- Second, Marian (2007) suggests that language and memory area are tightly connected entity. Using the evidence that certain parts of the brain are responsible for understanding words and sentences, WM can be considered a significant factor in language aptitude, followed by recent evidence from Miyake & Shah (1999) where it is regarded as a central component of language processing.
- In addition to the fact that testing and measuring cognitive abilities in general helps to estimate applicants' potential to use different mental activities; noting that, WM is taught to be the number-one system for stimuli perception, manipulation and recall.

2.5.5. Description of the measure (Working Memory)

Keeping in view the consideration of an existing association between Working Memory and Language Processing, we will provide in the next part the administration and description of WM measures.

Contrary to the standardized WM tests that are used in cognitive psychology experiments, which demand laboratory and clinical investigation; the current tests involve measuring WM Capacity mainly in foreign language.

Three different tests are included: "the reading span (RSPAN)" (previously mentioned and explained), and a designed website that contains two sub-tests created based on the "WAIS-IV" (c.f. 2.5.3.2). The sub-tests are named "Letter Sequencing Task" and "Word Span".

The Verbal Working Memory Capacity is the aimed measuring behind all these tests. As a case in point, RSPAN measures visual-verbal working memory capacity (sentences presented on the board by a Data Show). "Letter sequencing task" measures visuo-spatial WMC (recalling words and letters in a given order) and "Word Span" deals with auditory WMC.

2.5.5.1. The RSPAN Task

The RSPAN was the first presented test; it was directed to measure verbal working memory capacity, particularly visual-verbal WM ability. The test was presented on a data show device in order to give the examinees a visual perception of the stimuli. The participants in the RSPAN test were divided into four groups, each group contained twenty 20 subjects. (i.e., their actual division by the administration).

The test included nine tasks with an increasing number of sentences (from 2 to 8) to read and a digit appears in some tasks next to each sentence to remember (e.g., the boy loved his bike. K). At the end of every task/span, the participants were instructed to recall the digits in the order they were presented in or the last word of every sentence.

Nine sets of sentences were presented; each set contained a number of sentences ranging from 2 to 8. The first span included only two items, the second, three; the third and fourth, four sentences; the fifth had five; in the sixth and seventh, six sentences; the eighth had seven items to recall; and the last span presented eight items or sentences. (C.f. appendix 1)

The moment the participants felt unable to recall more sentences, the number of sentences stopped increasing and the last task's score was considered the highest.

For the scientific integrity, the sentences used in the task were taken from online language Reading Span Test (Cognitive fun, 2012) and from Reading Span (James Stone 2020); and they were re-designed to suit the Algerian socio-cultural context. Thus, the sentences or words that seemed unfamiliar or exceeded the level of the chosen sample were modified and changed (if needed) to certify the validity of the results.

2.5.5.2. Working Memory Test (website)

Our ability to work with different information has an important and a central role in learning process, from Acquisition to Comprehension and understanding. The tests such as

Direct & Indirect Digits test, the Wechsler memory Scale (WMS), the Continuous Performance Test (CPT), Visual Organization Task (VOT) and many other tests are used by researchers to measure working memory capacity and investigate its role in different everyday tasks.

Considering that the present research paper is dedicated to study the role of working memory as a cognitive function, on the process of learning English as a foreign language; we decided to create a test for working memory measuring.

The WMT was created/designed in a form of a website in order to allow access to mobiles and computers-users.

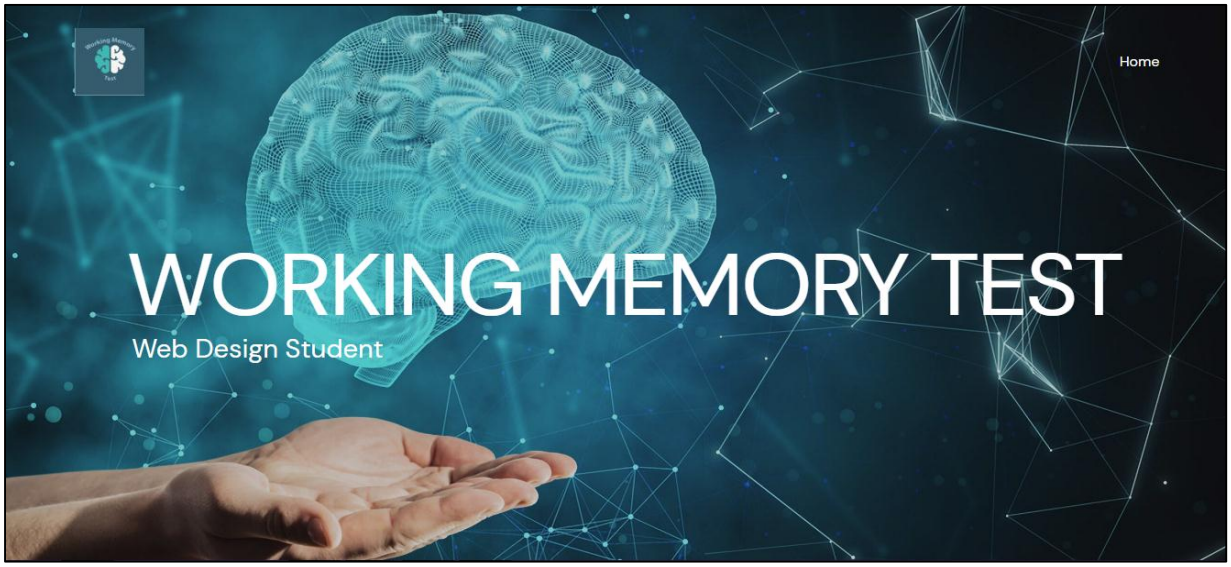

Figure 2.8 Working Memory Test (Designed by the researcher)

The website includes basic definitions and information about WM, types, characteristics for users to have an idea before passing the test (homepage).The creation of this page was done purposely to inform those who have no background knowledge about the field of Cognitive Psychology or Working Memory as a cognitive factor.

The website includes two subtests: “letter sequencing task” and “Word Span”. In addition, both serve the aim to measure the WMC with a slight difference in the presented stimuli in order to make the test challenging and avoid boredom.

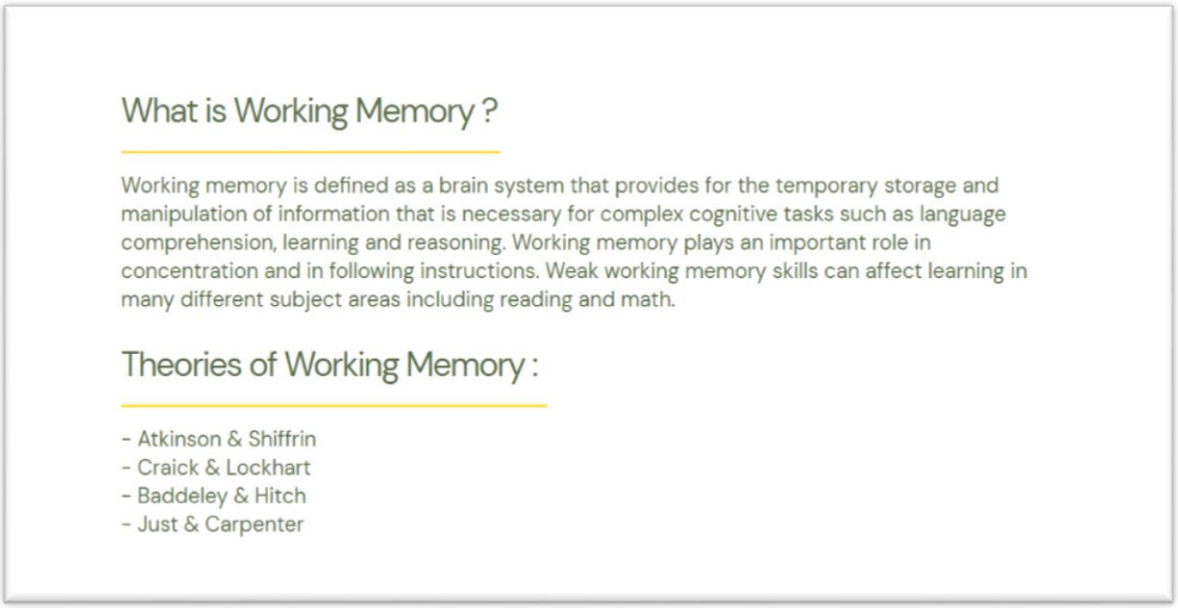

Figure 2.9 Working Memory Test-Homepage

After consulting the information on the home page, the examinee have the access to the two sub-tests separately; and the choice to pass both or only one at a time is also the tester’s decision.

a. First Online Sub-test: Letter Sequencing Task (LST)

This test measures an individual's working memory capacity in being able to process and sequence information. The task involves hearing/seeing a series of letters, and then reporting back the stimuli with the letters in an alphabetical order.

The aim behind this test is not only to measure individual’s capacity of storing an information but also the ability to manipulate it.

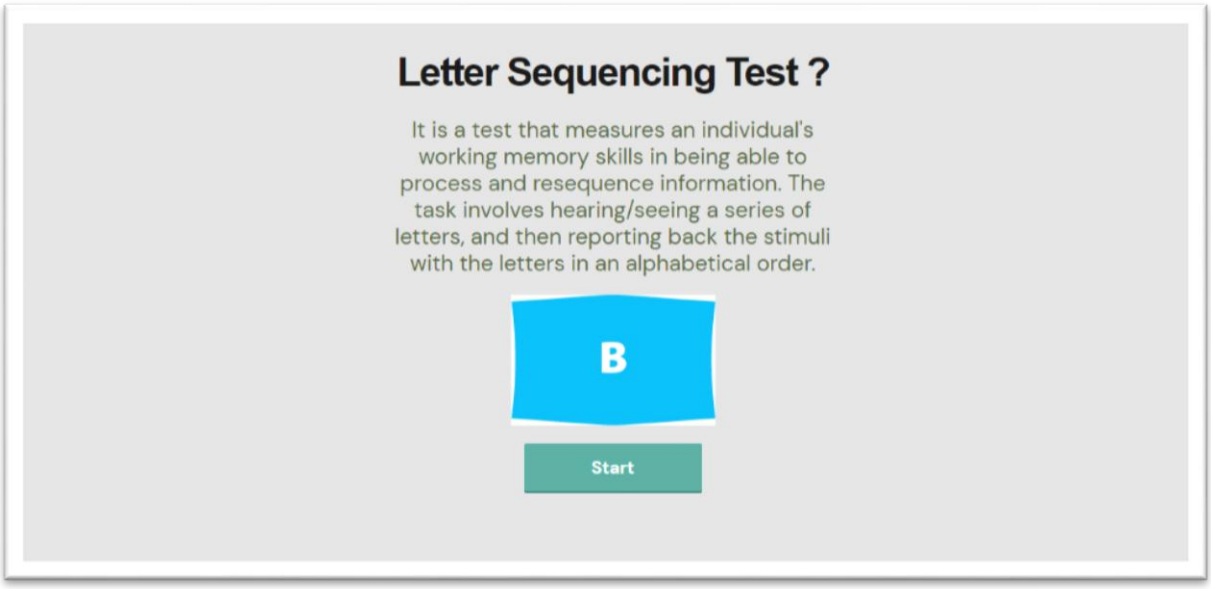

Figure 2.10 Working Memory test, Letter Sequencing Test

b. Second Online Subtest: Word Span Task

It is a test of one's ability to remember a list of words in sequential order (APA Dictionary of Psychology), The Word Span task consists of a list of stimuli. The stimuli are presented individually one per two seconds. The number of words increases from one word up to eight words.

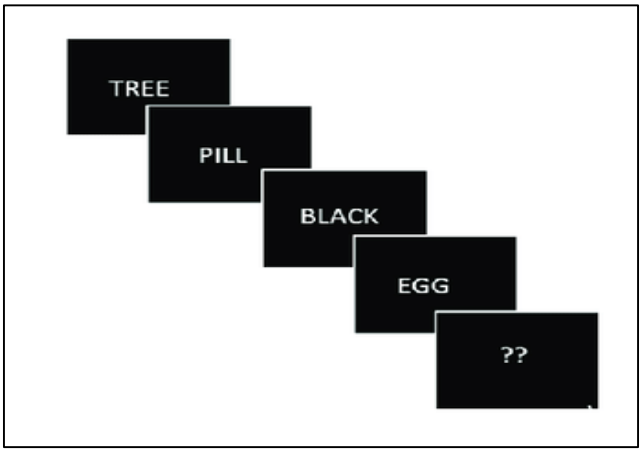

Figure 2.11 Basic Operation of the Span Test Examples of a simple span task

Both of the subtests aim at measuring visual-verbal WMC, and observe the subjects' ability to recall the list in the correct order. A more updated version of the test employs not only to memorize the digits (words) but must go through the manipulation stage for more valid/exact results concerning WMC.

2.5.6. Procedures

The performance of the WM measures was through the previously mentioned methods where we handed them to a population of 80 participants who were part of the three distinct test (RSPAN, Website tests). The process of measuring took place at private institutions (Skyline, Star Net, RIHI –Tiaret-) the examinees were separated into four groups (i.e. their actual division by the administration). The tests were examined during the same week at the beginning of May 2022. The choice of conducting the research and testing the WMC with the different tests in an identical time was for not affecting the test's scores since the same conditions will be provided (Time, Physical Environment, and Weather).

A well-explained and detailed presentation will be arranged further down in the section about the measure, physical environment, time and scoring procedures.

2.6. Selective Attention Measuring

Having emerged from the philosophers discussing the topic of humans being able to focus and concentrate on a giving item, idea or an information; attention became a central interest for psychologists and scientists, the continuous analyses and questions concerning the

field of attention lead to attention being scientifically researched and conducted as a fundamental topic in cognitive psychology. The mechanism of acquiring a stimulus and responding selectively is termed “Attention”; it is defined as the state in which our cognitive resources focus on a certain stimuli rather than others (APA Dictionary of Psychology).

Scientists were not interested only in the limited capacity of attention, but also in its duration and what factors control it. The several questions raised on attention required from us to review the history of attention measuring and the different tests created for that purpose.

2.6.1. Attention Tests

Attention is a cognitive function required for affective learning, reasoning and understanding. In addition, different types of Attention have been conceptualized in several models and theories.

The visual Attention was the first tested and measured type of attention in the study of Kane, Bleckley, Conway and Engle (2001), using “Antisaccade” tasks.

The “Antisaccade” task is an eye-movement tracking test used to assess the brains’ ability to reflex and focus on a giving item/information while being distracted by out-side factors. It also involves working memory as a high affective factor in the perception process.

Another task used by Kane and others (2001) is the “stroop task”, which is considered one of the best-known psychological experiments (Psytoolkit.org). It was named after the scientist John Redley Stroop. It demonstrates that the brain’s reaction time slows when it is confronted by conflicting information. The main idea of the task is to present a list of words (Colors’ names) written in different colors (e.g. the word RED written in blue...) to a number of subjects, and they were instructed to memorize these colors.

The results from this experiment found that both memory and Attention capacity were less when given incongruent stimuli; and those stimuli were called “Stroop Affect” or “Stroop Interference”.

As a conclusion, the examiners saying that WM is necessary to Attentional control and Attention is obligatory for the evaluation of executive processing abilities. The Stroop task was a test used for Selective Attention measuring.

The degree to which SA plays a significant role in executive functions and the distinction between different types of attention motivated researchers in general and psychologists specifically to create several tests aiming to measure the capacity and duration of SA as a brain’s function and ability.

The history of SA holds numerous tasks and scales, in the current investigation we decided to use the Dichotic Listening Task (DLT) since we are following the Bottleneck models (Broadbent and Treisman models), in addition to the fact of focusing more on the auditory form of stimuli/information.

2.6.2. The Dichotic Listening Task (DLT)

Ann Treisman (1964) using the “speech shadowing method” created the DLT in her experiment to measure individuals’ ability to selectively focus and process a given information/stimuli.

In the DLT, participants were asked to repeat aloud the speech played into one ear (the attended message) and ignore the speech in the other ear (the unattended message). The aim behind this task is define whether it is possible to focus when exposed to several stimulus and measure the SA capacity and duration.

2.6.3. Description of the Selective Attention measuring

Psychologists insist on using tasks such as the “Stroop task” for assessing Selective Attention, however, our research is all concerned with the role of SA purely on Language Processing whether the storage or perception of information requires the focus of Attention.

From this view, Dual tasks are believed to be the best tool for measuring SA capacity as Cowan stated in his book “Working Memory Capacity”. (Cowan, 2003)

- **The Dichotic Listening Task (DLT)**

The DLT is the most suitable method for the process of data collection in the current study. The subjects will pass two different sub-tests: DLT (1) and DLT (2).

The task involves presenting two different messages/passages through a set of headphones; it requires participants to be exposed to two passages simultaneously, one through the right ear and a different one to the left ear.

In the first sub-test, subjects will listen to one message and they were instructed to answer a set of twenty-five (25) questions about the given message, in order to measure their ability to focus and Attention’s capacity and duration. During the second half of the task (DLT), the participants will listen to two different messages and focus on one (e.g. the right ear message). The questions will be a paper-and-pencil test containing 25 questions all related to the attended message.

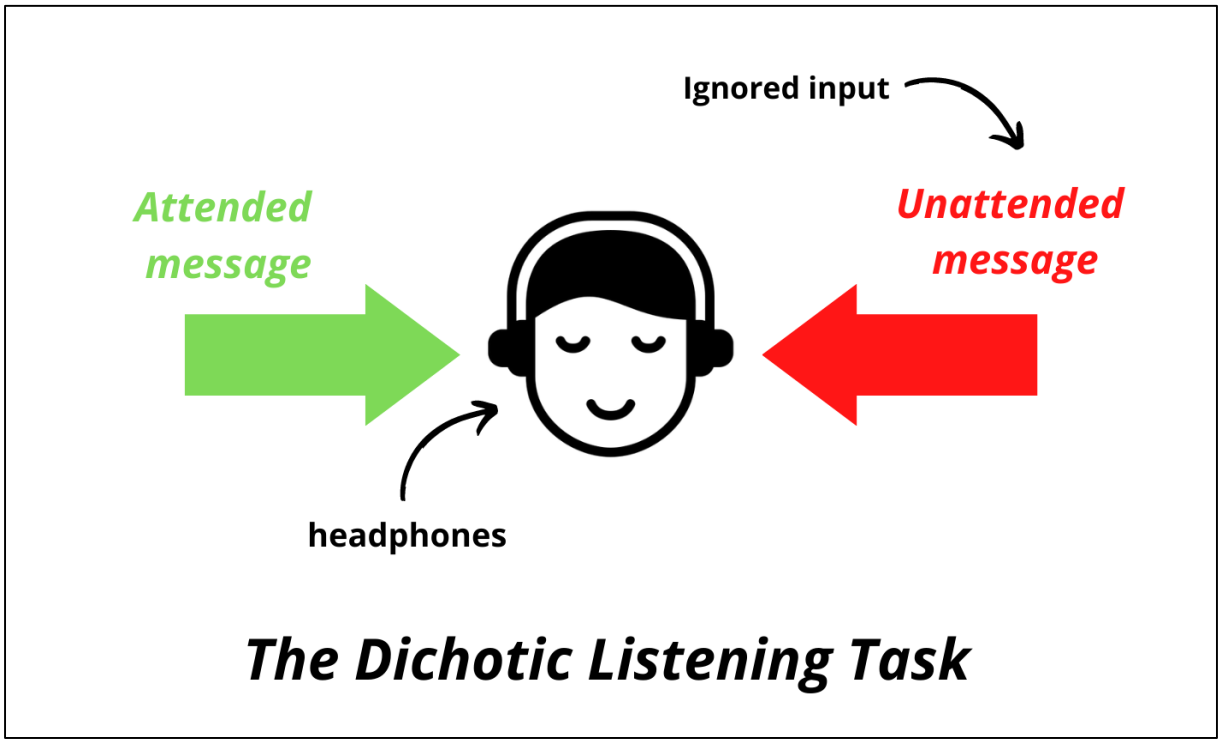

Figure 2.12 the Dichotic Listening Task

The unattended message is used to distract the examinees and observe their ability to attend to a given stimulus and ignore the distractive stimulus.

2.6.4. The Aim of measuring Selective Attention

Among the executive functions (EF) laying the foundation for language development, selective auditory attention (SAA) is thought to be one of the main EF involved in language processing since it effects listening skill. It also has been suggested that for how long we can focus on a task without getting distracted is decided by our SAA capacity since it is present in our performance for every day work.

Psychologists insist on using tasks such as the “Stroop Task” for assessing SA; however, our research is all concerned with the role of SA purely on language processing whether the storage or processing of information requires the focus of Attention.

From this view, “Dual Tasks” are believed to be the best tool for measuring SA capacity as Cowan stated in his book “Working Memory Capacity (2003): “if there is a focus of attention that sometimes plays a role in both storage and processing, then there should be instances in which resource sharing can be observed”. (P. 52)

Under the aim to measure SA capacity and investigate the effect and role of it on the language processing since we assumed an existing correlation between WM and SA, and both having an effect on Language in the beginning of this research paper. The Dichotic listening Task is used to assess SA as a cognitive function effecting Language learning and comprehension.

- First, DLT is an auditory process-based task and listening is one of the language skills.
- Second, if memory has an effect on the ability to store, hold and manipulate information, attention is needed for the perception and concentration, furthermore, unless an item is paid attention to, the human brain cannot process it.

2.7. Administration of the Measures

2.7.1. Administration of Working Memory measuring

As mentioned above, eighty examinees were ready to pass the WM tests. They were divided into four groups, each group contained twenty subjects. Working Memory tests were administered the first at 08:00 a.m. the time choice was based on the fact that this time in the

morning grants the best performance from participants since they were not exposed to any type of cognitive process or activity. The tests were administered one after another, the first was the Letter Sequencing Task from the web site, each tester had his/her own device to access to it; followed by the Word Span task also through the website.

The RSPAN was the last test passed in the presence of the researcher with the help of some other organizers to observe the participants in order to ensure that all of them completed every measure correctly. On some occasions, the researchers helped to classify some words or check the functionality of a button in the web site. Between the different tasks/tests, examinees were given a break of fifteen minutes (15min). The participants were instructed to sit one in a table and avoid contacting the others, so the scores will reflect their real capacities and abilities.

The perception of the stimulus was presented in two ways, first through the data show in the RSPAN, and second through the website on tablets, phones or computers. (Working Memory Test)

Responding to RSPAN was done on a paper handed by the examiner and numbered in order to make it easier for the respondents. On the other hand, answers on the website were saved anonymously and whenever the examinee failed to remember the sequence of the stimuli, the test stops and the result appear on the screen. Scores for every test/sub-test will be discussed forward in the section "Scoring Procedures".

2.7.2. Administration of the Selective Attention measures

After a break of thirty minutes (30min), the second measure took place (i.e. Dichotic Listening Task was undertaken at 10:00am). In the interest of standardization, the DLT was performed through a presentation of recorded passages (audios) using headphones. Two different audios were used with all the instructions necessary for the examinees to pass the task.

A written form of the two passages with the phonetic transcription is provided (c.f. Appendix 2).

Each group took approximately one hour (1h) to complete the task DL. It was previously mentioned that the groups of participants were in separate rooms to make the supervision possible for the organizers. The button "play/start" was clicked whenever the students were ready to pass the test. After listening to the full audio-recorded passage, a paper of twenty-five questions (25) was handed by the examiner to the subjects to answer and measure their SA capacity based on their scores.

The researcher along with the organizers made note or helped whenever they noticed a participant doing the task incorrectly or struggling with the headphones.

The audio-recorded passages were short stories in a simple clear language recorded by a voice of a teacher in the English Section – Ibn-Khaldun University; a teacher's voice choice was to make sure the audio is understandable and the pronunciation is correct.

2.8. Scoring Procedures

Since it was hypothesized in the beginning of the research that working memory and selective attention share a correlational effect and they would be components of the overall language learning process; it is required from us to decide an identical common score to be the score of perfection for every measure.

Scoring the data involves assigning a numerical value to each response on an instrument. From this belief, the score 100 has been chosen for both SA and WM tests. Based on what has been mentioned, the score will lead to the appearance of five different classifications or percentiles as follows: 50 is the mean capacity level, scores ranging from 25 to 75 show "average capacity level and scores below 40 show the level "below average" and more than 60

the level “above average”. Scores higher than 95 and lower than 5 are considered exceptional since it is rare to find such level when measuring cognitive functions and mental abilities.

Taking notice to mention that the distribution of scores was based on a previous research done to measure Intelligence (Elmechta, 2016).

The working memory measure was based on three sub-tests, accordingly the score 100 was divided on them. The RSPAN task received the highest score (40/100) and the two subtests from the web site were scored on 30 for each. Since the questions have been ordered in an increasing pattern, they have been given increasing scores.

While scoring in the website (during the design and creation part), the more digits or items the participants were asked to remember, the higher the score has been given. The first was two points (2points) and it increases by half a point (0.5point) for every level. This means recalling one letter gives two points (2), two letters (2.5points), three letters (3pts) and following this pattern until eight letters (8) which is the highest number of items and it equals (5.5pts).

Based on this scoring process, the person who can recall every single item from one to eight scores thirty (30pts) as the highest score for both of the online tests: the “Word Span” and the “Letter Sequencing Task”. (Appendix 3)

As for the distribution of scores in the RSPAN task, viewing that the test contained different tasks with an increasing number of sentences for each task; the scores as well followed the same scoring procedures. The only difference is that the scores given to items were different since the task includes short and long stimuli.

The distribution of scores for every task and recalled items is explained in the following table. (Table 2.1)

Spans / Scores (pts)	Span 01	Span 02	Span 03	Span 04	Span 05	Span 06	Span 07	Span 08	Span 09	∑
RSPAN	0.5	3	2	4	2.5	3	6	7	12	40
Word Span	2	2.5	3	3.5	4	4.5	5	5.5	--	30
Letter Sequencing Task	2	2.5	3	3.5	4	4.5	5	5.5	--	30

Table 2.1 Distribution of scores of Working Memory Measures

2.9. Pilot Study Procedures

A pilot study can be defined as a small-scale test of the research methods, tools, sample and all the research strategies and techniques under the purpose of testing and examining the feasibility and validity of data collection instruments.

2.9.1. Working Memory Pilot Study

The pilot study in the current research started from the creation of the very first version of our website "Working memory test". In our case, it was a primary step to test the organization of the measures' items and questions from easiest to most difficult and this required the comparison between the percentages of the answers.

We also considered updating the website whenever a problem appeared. The first created test was a mobile application, and since the access was limited only to users of mobiles and specifically smart phones with Android system; we sought to change it into an online website.

The Online Test (WMT) went through several updates and versions until we reached the ideal one (current one). It is worth mentioning that the website still needs modifications and the gaps within it are mentioned later in the research limitations.

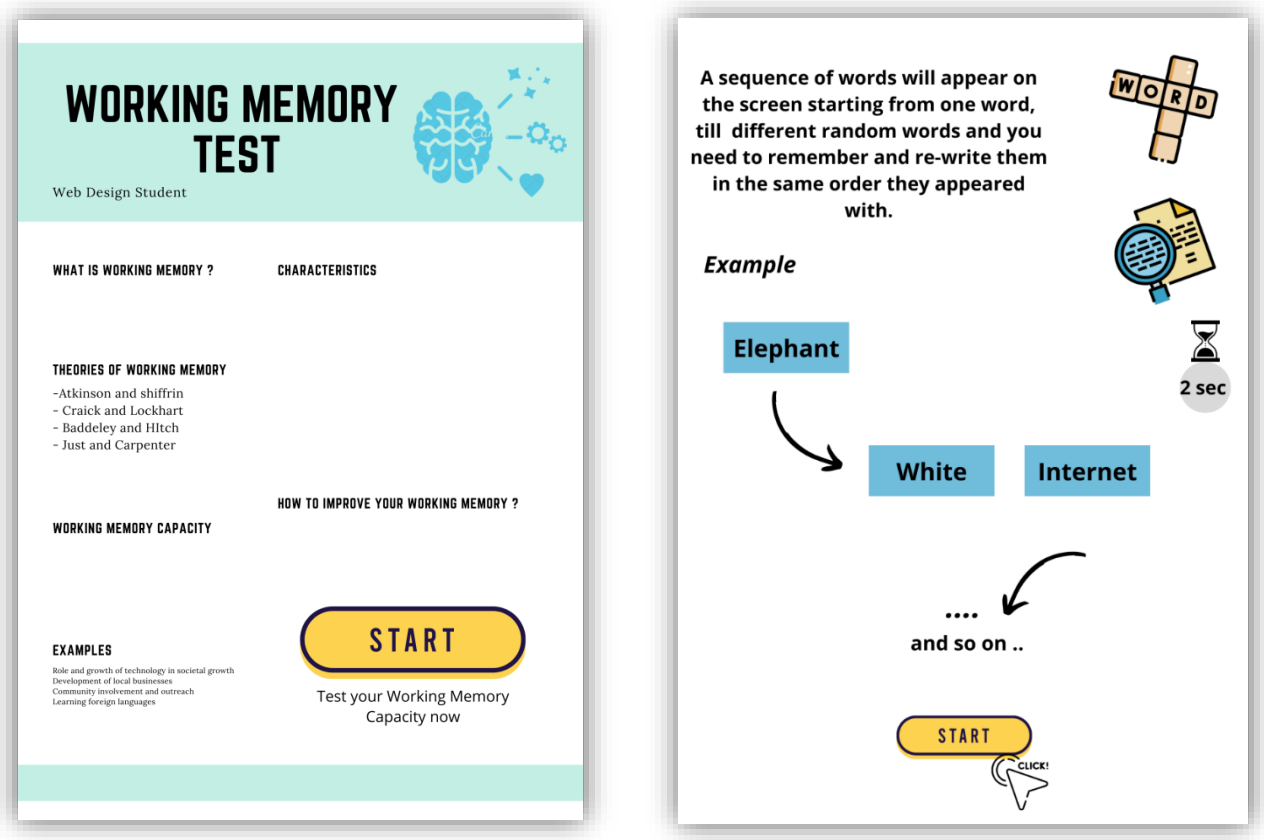

Figure 2.13 the Simulation of the website

The items selected for the process of recall should be challenging yet not hard to remember so they would be accessible for everyone. Therefore, the digits whether they were numbers, letters or words were selected carefully and tested during the pilot test to avoid ambiguity.

The pilot study informs us about "Performance time" and what is the most suitable and sufficient time for individuals to answer and for the stimuli to appear. We used chronometer to count time spent in each question and calculated the mean for time, which varied differently from one test to another.

2.9.1.1. Pilot Study Sampling

A sample of two groups was chosen randomly from a population of A1 level learners from three private institutes (i.e. Skyline, Starnet and Rihi) at Tiaret. The division of the groups was as well random. Twenty individuals including eleven 11 females and 9 nine males were involved in both working memory and selective attention pilot tests, and the mean age was M (age) = 18 years old. (It ranged from 16 to 23)

2.9.1.2. Working Memory Pilot Test Results

Since the aim behind the pilot study is not to measure the working memory capacity but to evaluate the understanding of the questions and tasks and make changes when needed, participants were asked rather than answering to underline the difficult or unclear questions. In addition, we used a mobile chronometer to write down the spent time for each question and by each individual.

The first subtest was the Reading Span task, we noticed the subjects did not face much unclear/not understood words except for five words and they replaced by clear ones. (C.f. Appendix 4)

Regarding "timing", the time ranged from thirty minutes (30min) to one hour (1h), based on that we decided forty-five minutes (45min) for RSPAN task. Details and description of the test procedures were discussed in the administration of WM tests. (C.f. chapter 2.7.1)

2.9.2. Selective Attention Pilot Study Results

The selective attention pilot study was a paper-and-pencil test containing ten questions that aim to measure SA capacity and duration, which are decided by the number of answered questions and recalled items since the examinees were exposed to two different passages. The passages were in a form of separate unrelated sentences.

The observation of the participants' answers revealed that some individuals were struggling to answer or focus on one passage (the attended message). We suggested that the reason might be the unrelated sentences, which created some type of ambiguity and absurdity. Based on the results from the SA pilot test major modifications applied to the SA tests. (C.f. Appendix 5)

2.10. Conclusion

To create a clear structure for this study and link between its different parts, in this chapter we started with a restatement of the research questions and hypotheses, as well the methodology and data collection instruments. The instrumentation part followed to illustrate the different data collection procedures along with the history of measurements of research variables. A pilot study for measuring these variables was conducted to confirm the validity of the collected data.

Since working memory and selective attention are the central factors in the present research, we went through aim, description and administration of every test and scale. After the participants obtained their results in the tests, we relied on scoring procedures for more valid and credible data. The discussion of the results with testing research hypotheses and the interpretation are discussed in the third chapter.

Chapter 3:

Findings, Discussions and Data Analysis

Chapter Three

Findings, Discussions and Data analysis

Chapter 03: Findings, Discussions and Data Analysis

3.1. Introduction

This correlational study sought to discover whether a relationship exists between the cognitive functions "Working Memory" and "Selective Attention" and to what extent they both effect Language Learning and Comprehension. The chapter is devoted to the presentation of the obtained scores and analysis of different measures.

It offers an analysis of the distribution of scores along with the examination of research hypotheses. The following chapter will include two main sections, data analysis and evaluation of the research hypotheses succeeded by the interpretation of the results.

3.2. Working Memory Measure Findings

The first cognitive function and research variable, which is working memory, was measured including three distinct sub-tests: RSPAN, Letter Sequencing task and Word Span. The analysis of each subtest results is provided below in the section.

3.2.1. RSPAN Findings

The RSPAN task included nine tasks/spans; each task involved a set of sentences increasing from two sentences (first span) to eight sentences (ninth span). As mentioned previously the subjects were asked to recall the last words appearing at the end of the sentences after reading aloud every sentence. The stimuli varied from short to long sentences and some of the tasks instructed the examinees to recall the item appearing at the end of the sentence rather than the last word of the sentence for a more challenging nature of test (e.g. "the girl bought a dress" K, the recalled item is the letter K)**.**

The test started whenever the stimuli shows on the screen using the data show; when the information disappeared the recalling step starts and examinees had to start writing down the answers. No individual was allowed to write before the stimuli disappeared. After the nine tasks were all performed, the scores were calculated (c.f. table 2.1). The following table indicates the number of subjects who completed the task correctly.

RSPAN Spans	**Span 1**	**Span 2**	**Span 3**	**Span 4**	**Span 5**	**Span 6**	**Span 7**	**Span 8**	**Span 9**	
Level / Scores	**Low 0 - 9.5 pts**			**Average 9.5 – 30 pts**			**High 30 – 40 pts**			**∑ = 40**
Participants	**6**			**54**			**20**			**∑ = 80**

Table 3.2 RSPAN subtest results

Discussion

According to the data illustrated in table 01, the scores from RSPAN were classified into three different sections demonstrating the levels of working memory capacity. The capacity based on the RSPAN test tends to range between the third and sixth spans (∑ = 54). The data obtained reveal also that the highest number of students centers in the Average level.

It can be seen from the RSPAN scores (Appendix 6) that it is possible to consider the WMC of 4 (±2). These expectation are in keeping with Cowan's view of working memory capacity 4 (±1); the only change here is that it might be recommended to add an item to Cowan's claimed capacity/magical number "four".

Beyond, some of the participants showed whether a low or low or high WMC in the RSPAN. (E.g. among the high leveled section, eight (8) participants had the highest scores close to the perfect score 40points. The possible explanation might be that those with very high scores

are assumed to be familiar with reading tasks or are able to read quickly. On the other side, those with a very low capacity score are believed to focus on reading more than the process of storage and manipulation.

It is worth stating that the main objective behind working memory measures was to estimate the role of WM in the second language. Consequently, the emphasize was on language processing including its different strategies. The researcher observed during the test the lack of knowledge of some words and the production of incorrect recalled ones. (e.g. "dull" instead of "doll", "sweat instead of "sweet", the letter I instead of E" ... to name but a few).

It was remarkable to note that the letter tasks (span 1, 2, 3, 6) were recalled better than the ones with words or without a distractive item appearing at the end. In addition to the language proficiency which had a huge influence on the recalling process/operation. As long as the examinees were unfamiliar with some words, they were unable to recall or memorize them. In some cases, participants recalled only the first letter of the words. (E.g. one of the participants stated, "A word starts with the letter S, but I cannot remember it!" when the word was "superhero").

Another worth mentioning issue is that the subjects do not concentrate or get distracted by the slightest noise or movement of one of the organizers; which is explained by the absence of Attention.

During the RSPAN task, participants were able to recall the first and last item easily and always struggled to recall the digits in the middle. This observation add evidence to the stated by Baddeley in the "Phonological loop" (1974). (C.f. chapter 1.2.2.3.1.a)

Similar to the above-mentioned effects, the "word-length" in another aspect in the analysis of WM measure (RSPAN). The longer the word is, the harder it is recalled and vice

versa. When reading short ideas (i.e. tasks 1, 2, 3) the recall process appears to better than when being exposed to long items/words (i.e. tasks 7, 8).

In the WM measure (RSPAN), the function of Attention is observed to have an effect on the recall operation. The participants were distracted by the atmosphere in the classroom or even by the recently perceived stimuli. For instance, during the seventh task, there was the word "frustrated", when being asked about the word, a great number of examinees responded "furniture" instead of "frustrated" since they start with the same letter "F". The influence of the recalled words was obvious and remarkable during the whole task.

3.2.2. The website Working Memory Test

Following the procedures mentioned earlier, the subjects were given a device a device (phone, tablet, or computer) and had access to the website "workingmemorytest.quickconcept.dz".

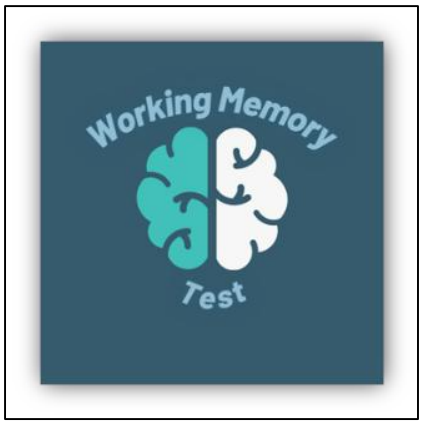

Figure 3.14 the website Logo

3.2.2.1. Letter Sequencing task Findings

The first administered subtest in working memory measure was the "Letter Sequencing Task" (LTS). As it has been discussed previously, this sub-test was created and designed to assess the manipulation operation. Two different processes were included: the storage and recall of the letters, and the alphabetical ordering of them.

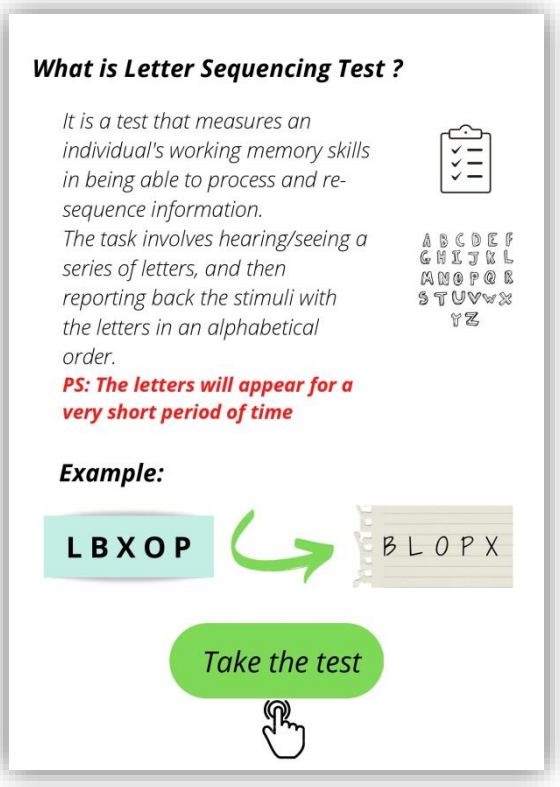

Figure 3.15 Letter Sequencing Task subtest (simulation webpage)

The test LST encompassed eight tasks that aimed at assessing the WM measure focusing on the process of manipulation of information. The scores differed from one task to another based on the items to recall and store. The findings of this subtest were stored on the website and illustrated in the following table.

Answers	Number of participants							
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
Correct	80	80	80	78	71	55	17	8
Incorrect	00	00	00	2	9	25	63	72
Percentage %	100%	100%	100%	97.5%	88.75%	68.75%	21.25%	10%

Table 3.3 Answers and Scores from the Letter Sequencing Task

Discussion

The above table (3.3) indicate a variance in the variety of tasks in the LST subtest. The percentage in the first three tasks indicate perfect ability/capacity (N = 80 / 100%). The examinees were able to recall the stimuli and present it correctly. Starting from the fourth task, subjects started to make mistakes (i.e. presenting the items unordered or a part of the stimuli is missing). Based on the system of the online test, whenever a participant failed to recall the sequence of letters, he or she was eliminated and the final score appears on the screen with a detailed list of the results for each task. The following figure presents how the results are presented.

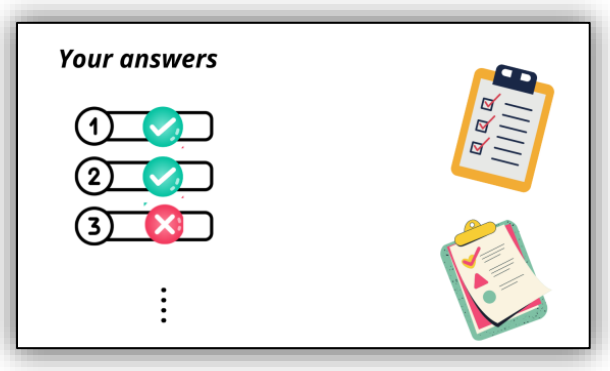

Figure 3.16 final results (simulation webpage)

Though differences were evident, the majority of the participants' scores are observed to range between 11 and 19 points, which are the scores related to the fourth and sixth tasks. (C.f. Appendix 7) Based on the data from table (3.3), only eight participants finished the task and recalled all of the exposed items.

Based on the pilot study results the time of the stimulus appearing on the screen was modified to be increasing from one second to four seconds. The longer the sequence of letters was, the longer time it took. Since the subtest included eight tasks, the first four tasks had a time of two seconds (2sec), the last four tasks had three, four seconds (3-4sec) in order to facilitate the process of recalling and manipulation and to give the sufficient time for the brain to assess the information. (Cowan, 1988)

Regarding the Letter Sequencing Task, the obtained scores assembled to a large amount of evidence in support of the view of Cowan about the capacity theory and how the working memory has the ability to hold five items at maximum before the individual starts to face difficulties recalling.

3.2.2.2. Word Span Findings

Similar to the LS task, the "Word Span" was performed via the website "Working Memory Test" using a device by choice. The examinees were instructed to follow the instructions on the screen. The obtained data are illustrated in the following table (3.4).

Answers	Number of participants							
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
Correct	80	80	80	75	62	41	25	8
Incorrect	00	00	00	5	18	39	55	72
Percentage %	100%	100%	100%	93.75%	77.5%	51.25%	31.25%	10%

Table 3.4 Answers and Scores from the Word Span subtest

Discussion

It is worth mentioning that the first three tasks same as the LST indicate perfect working memory capacity (N = 80 / 100%). The examinees all reached the third task easily. The observation of the table indicates that the working memory capacity in the task "word span" is lower than that of the LST. The predicted reason behind this variance of scores between the two subtests might be due to the difference of the stimuli's length. The items in the WS test were "words", and the length of these words increases with tasks (from one-syllable words "doll, dress ..." to words with four syllables "superhero …").

It is noteworthy to mention that the same eight examinees who scored the perfect in the previous subtest (30) were able to complete the second subtest (WS) and had the same score

as well (30). The majority's working memory capacity in the word span subtest seemed to reside in the fifth task ($\sum = 62$), which indicated a limit capacity of five items (same as Cowan's statement in 2000). (C.f. chapter 1.2.3)

In addition to the differences concerning working memory capacity among individuals that the word span subtest revealed, it revealed as well their differences in language proficiency. Long words were a real struggle to some participants since they were not only unable to read the words; but also unable to store and manipulate it because of the lack of any background knowledge (concerning the word). The longer the set of words in the stimuli, the harder it was for participants to recall them.

One of the recalling processes was present in this subtest, "chunking" which refers to the recording of small units of information into larger/longer ones, to help recall later and improve the amount of stored stimuli. A good few of the subjects, despite the fact that they failed the tests (task 07); they were capable of recalling the words unordered in a form of groups (two words assembled).

3.3. Selective Attention Measure Findings

Two tasks were administered to measure the selective attention capacity (SAC) and duration; the discussion of the results and obtained scores from both tests is provided below in the section.

3.3.1. Dichotic Listening Task Findings

The Dichotic Listening Task (DLT) in the current study included two subtests. The first aimed at measuring the ability/capability of individuals to focus on a given stimuli. The second subtest measured the capacity and duration of the selective attention as a cognitive function based on listening to two different passages (considered two sources of stimuli) and

instructed to focus on one passage (the attended message) and ignore the other passage (unattended message). The two stimuli were in a form of a recorded audio and then the organizers handed a paper with twenty-five questions (c.f. Appendix 2). The answers of the questions will reveal the capacity of SA among participants.

The findings of this subtest are presented in table (3.5), alongside with the calculated means and percentages. The DLT (1) refers to the test with only one passage to hear, while the DLT (2) refers to the task where participants were instructed to listen to two stimuli in both ears. The scores are on 50, which is the highest score within the pair of the subtests.

Tests	**Participants (N)**	**Mean ($\bar{x}$) /50**	**Percentage (%)**	**Standard Deviation (SD)**
DLT (1)	80	42.45		8.329
DLT (2)	80	16.98		10.248

Table 3.5 the Dichotic Listening Task scores and means

Discussion

Based on the above table (3.5) one can notice that most of the respondents' scores in the first subtest (DLT 1) are close to the perfect score (50). The results as it is shown above prove that the subjects had high scores when not exposed to distractive stimuli.

The examinees listened to the passage carefully in one ear (right ear) using a set of headphones and then they were instructed to answer the twenty-five (25) questions related to

the passage and the majority found it easy to answer and hand the paper in less than twenty minutes (20min).

The researcher during this test observed the participants to ensure the continuity of the research and no environmental factors had an influence on them. One of the accurate observations that occurred frequently in the use of one hand to block the left ear since it had no message. This indicates that the concentration is a very effective aspect in the tests of attention; furthermore the examinees directed their focus, attention and listening to the passage to make the process of recalling the stimuli possible later.

Since the second subtest (DLT 2) is concerned with the capacity of selective attention, which is represented in the focus of the attention on one particular stimulus, and exclude of the other (s), the researcher along with the organizers observed how the participants manage to listen to one ear's message (attended) and ignore the other.

The participants were initially exposed to a short document using the data show to explain the process of the DLT (2). The headphones were tested using some simple sentences in order to ensure that they work and the testers confirmed it. (C.f. Appendix 8). Speed and accuracy were emphasized and before the beginning of the tests, every subject stated that they were ready. The button "start" was clicked at one exact time for the four groups. When the listening part ended, the subjects started immediately answering on the paper, which was already on the table faced down.

The scores in the DLT (2) ranged between zero (0) and forty (40), the mean was M = 16.98. Six subjects scored zero (0pts) out of 50 which means they were unable to answer any question and failed to focus on one message. The score 40 points is assumed the highest obtained score in the DLT (2) subtest and it repeated three times. (C.f. Appendix 9)

3.4. Distribution of Scores

We aim to spotlight the distribution of participants' acquired scores in the five administered measures in this subsection. At the very beginning of the current research we have hypothesized that both "working memory" and "selective attention" would be connected and as a unity have an effect on Language Learning and Comprehension. Towards that objective, a distribution of the measures' findings is needed.

In any experimental correlational study, we can graph tests' scores in the form of a curve. The shape of the distribution of the scores will be reflecting the mean, Standard deviation and where most of the scores are centering.

We calculated the mean and the standard deviation of each cognitive measure results, working memory and selective attention findings in order to investigate the distribution of the present measures scores. The SPSS "Statistical Package for the Social Sciences" was used in these analyses. The operation was done through the following options: 'Analyze', 'Descriptive Statistics', 'Frequency', 'Graphics' and choose 'Histogram'. The following graph was obtained for the scores of the Working Memory measures from the three different subtests.

Generally, when the greatest number of the scores/values exists in the center of the curve and composes the highest point, which refers to the mean; it is called a "normal distribution in a bell-shaped curve.

M = 61.94

SD = 17.749

N = 80

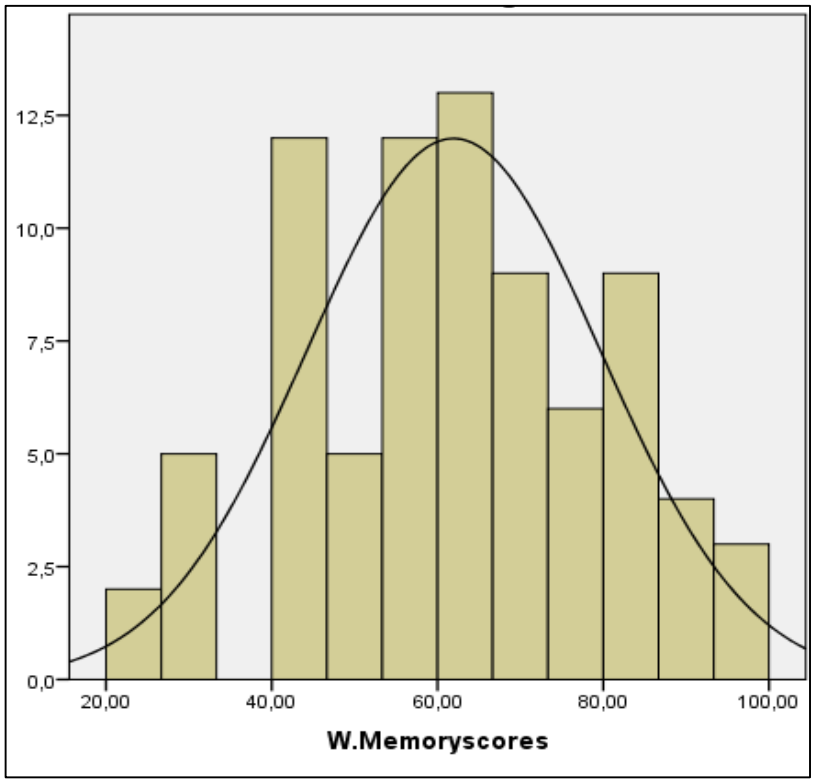

Figure 3.17 Distribution of Working Memory scores in the Curve

The figure displays the working memory scores as a normal distribution curve with a mean of 61.94 and a standard deviation of 17.749. Following the distribution of psychologists (Pearson, 1904; Thurston, 1938; Guilford, 1958; Horn and Cattell, 1967) we can estimate a percentage of 67.5% from the population their scores are situated between -1 standard deviation (i.e. 44.19) and +1 standard deviation (i.e. 79.68), with 97.5% scoring between -2 standard deviation (i.e. 26.44) and +2 standard deviation (i.e. 97.429).

The graph demonstrates that the scores among the subjects in the WM measures are distributed around the mean (M = 61.94) suggesting different working memory capacity levels. The scores varied from “below average” to “above average” close to the perfect score 100 points. Besides, unlike graphs and curves that demonstrate the distribution of scores only, the working memory distribution of scores curve reflects the Working Memory Capacity stated by

researchers in the field of Cognitive Psychology earlier (Cowan, 2000; Miller, 1956, c.f. 1.2.3). It is worth stating that working memory capacity varies per individuals; however, the standardized limit for this capacity is agreed to be five 5 (±1).

The results from the Selective Attention measures are illustrated in the figure (3.18) along with the calculated mean and standard deviation.

M = 59.30

SD = 16.252

N = 80

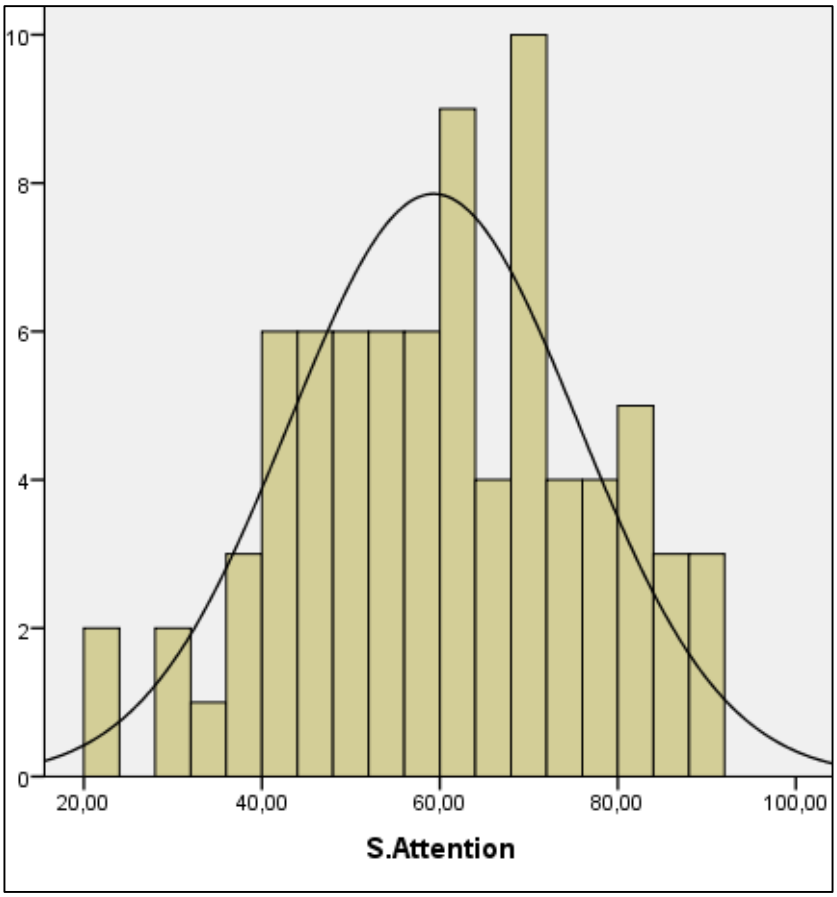

Figure 3.18 Distribution of Selective Attention Scores in the curve

Similar to the working memory results, the selective attention results are also observed to follow a normal distribution with mean 59.30 and the standard deviation of 16.252. The above shown distribution indicates that there are practically 63.75% of the subjects' score situated between -1 standard deviation (i.e. 43.048) and +1 standard deviation (i.e. 75.55). In addition to approximately a percentage of 97.5% of the sample whose scores are positioned from -2 standard deviation (i.e. 26.79) and +2 standard deviation (i.e. 91.80). The above graph resembling to the "WM scores distribution curve" demonstrates the scores centering on the mean (59.30). The distribution represents the individuals' variance concerning selective attention capacity which ranged from "below average" (e.g. 22 points) to "above average" (e.g. 60 points) and even "superior" (e.g. 90 points). (C.f. appendix 9)

The two different subtests demonstrated that the ability and capacity of selective attention as a cognitive factor appears when being exposed to more than one stimulus. The following table indicates how the scores in the DLT (1) were close to the perfect score and participants did not face problems answering the task questions. When on the other side, the DLT (2) appeared to be complicated and most of the subjects could not recall an idea from the two exposed passages.

	DLT (1)	DLT (2)
The Mean ($\bar{X}$)	42.45	16.98
Sum of scores ($\sum$)	3396	1358.5
Standard Deviation	8.329	10.248

Table 3.6 Means of the Dichotic Listening Tasks

One simple idea can be assumed from the analysis of the different measures' scores distribution is that the results show a normal distribution in the whole population. This might be a first step in the discussion of cognitive functions' capacity to prove an existing correlation between working memory and selective attention.

3.5. Reliability of the measures

It is impossible to draw valid conclusions in a research study unless we are sure that the test used for the process of data collection is reliable. The reliability of a test/measure refers to how consistently it testifies a variable. This former is practiced through the calculation of the correlation between the different subtests used in the measurement of the scores. Having used SPSS software to assess the reliability of working memory measures, and relying on the Pearson correlation Coefficient technique, these are the results displayed in the following tables.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
,787	,801	3

Table 3.7 Reliability Statistics of Working Memory Measures [5]

[5] The Cronbach's Alpha value appears to be 0.787 ≈ 0.8, which refers to an acceptable internal consistency.

	WordSpan	LetterSTask	RSPAN
WordSpan	1,000	,573	,574
LetterSTask	,573	1,000	,570
RSPAN	,574	,570	1,000

Table 3.8 Inter-item Correlation Matrix

	WM Total score	**Word Span**	**Letter Sequencing**	**RSPAN**
Mean (M)	**61.94**	**61**	**64.13**	**60.3**
Minimum score	**20/100**	**7.5/30**	**7.5/30**	**3.5/40**
Maximum score	**97.25/100**	**30/30**	**30/30**	**38/40**
Sum (∑)	**4955.5**	**1464**	**1563.5**	**19.29.5**

Table 3.9 Sum and means of the Working Memory measures

Checking the association between the working memory overall measures and subtests is not going to only investigate the reliability but as well help to decide which measure is the best for assessing such a cognitive function. The mean within the different tests appears to be close if not identical to the mean of the total working memory capacity (M = 61.94). This observation in addition to the findings of the correlation between WM whole score and the

scores from the different tests have guided us to discover which test is the most reliable one when measuring working memory capacity (WMC).

Based on the obtained data presented in the tables above it is clear to state that the three different working memory measures/tests: the reading span, letter-sequencing task and word span are all reliable in measuring the WMC.

Concerning the selective attention measures, the "Dichotic Listening Task" was administered and since it is a standardized measure and used among the psychologists we can assure its reliability for assessing Selective Attention Capacity.

3.6. General Discussion

After offering a full analysis of the findings of each measure, and providing detailed analysis of the distribution of the obtained scores in a form of tables, graphs and figures, it is apparent that individuals' capacities vary significantly. We observed this variance from participants who struggled to attend to one message and ignore the other, to participants who scored almost perfectly in every test and recalled most of the stimuli. Scores ranged from the lowest obtained by some participants who were unable to recall the easiest simplest stimuli or hear a simple passage, to the highest scores by subjects who surpassed all the tests with the almost perfect scores.

Regarding the working memory measures, the table above illustrated the means from the subtests used to measure its capacity. The observation reveals subjects' results in the two subtest from the website being higher than the scores from the RSPAN task. We would explain that the RSPAN was the most demanding and complex task since it required participants to focus, read aloud and recall the stimuli. It instructs the manipulation of information (reading),

storing the stimuli (memorization) and the recall of it in the order it appeared in. In contrast, the Word Span and the Letter Sequencing tasks were presented via the website, which made the answering process easier since all it demands is a click on a button.

Determining the subjects ability to attend to a given stimulus and ignore the distractive factors required the researcher to not center the observation only on the performance during the test (dichotic listening), but to control the atmosphere and spot any strange attitude or behavior among subjects.

The observation of the scores from the DLT (2) indicate a mean of 16.98 out of the highest score, which is assumed 50. This result states that individuals' capacity of SA relies on their ability to derive their focus and concentration on a given item/subject neglecting any outsider factors.

The analysis of the distribution of scores within both of the measures indicates the highest point in the curve (created using SPSS software) is approximately identical to the value of the average score (mean). The exceptions in scores were about the lowest or perfect scores only. The majority of the scores and answers proved the theories reviewed in chapter one (c.f. chapter 1.2.2).

The sample we designed for our research seems to range from mediocre to perfect/superior leveled individuals. Furthermore, the results obtained will cover different levels of WMC and SAC along with the application of different recall processes (grouping, chunking ...).

It is worth mentioning that Sex differences in performance were not included within the current study since the focus was on the capacity of individuals despite their gender.

3.7. The Research Hypotheses and Results

The purpose of this quantitative correlational study was to discover whether a relationship exists between WM and SA for A1 level learners at private institutes – Tiaret. The findings and the results that we came up with so far offer us the opportunity to conceptualize the correlation between working memory and selective attention and their effect on language processing.

In this section, the researcher discusses the research results and findings with regard to the research questions. It involves correlation between the research variables and examination of the research hypotheses.

The research question 1 asked whether a statistical significant correlation does exist between the two cognitive functions "working memory" and "selective attention". Two primary hypotheses were suggested.

- **Hypothesis one:** Yes, there is a statistical significant correlation between working memory and selective attention.
- **Hypothesis two:** No, there is no statistical significant correlation between working memory and selective attention.

The testing of these hypotheses will be done through a correlational study in an effort to reflect the strength and the direction of the relationship between the research variables (WM and SA).

3.7.1. Measuring the correlation between Working Memory and Selective Attention

Pearson's correlation coefficient

$r = 0.9$

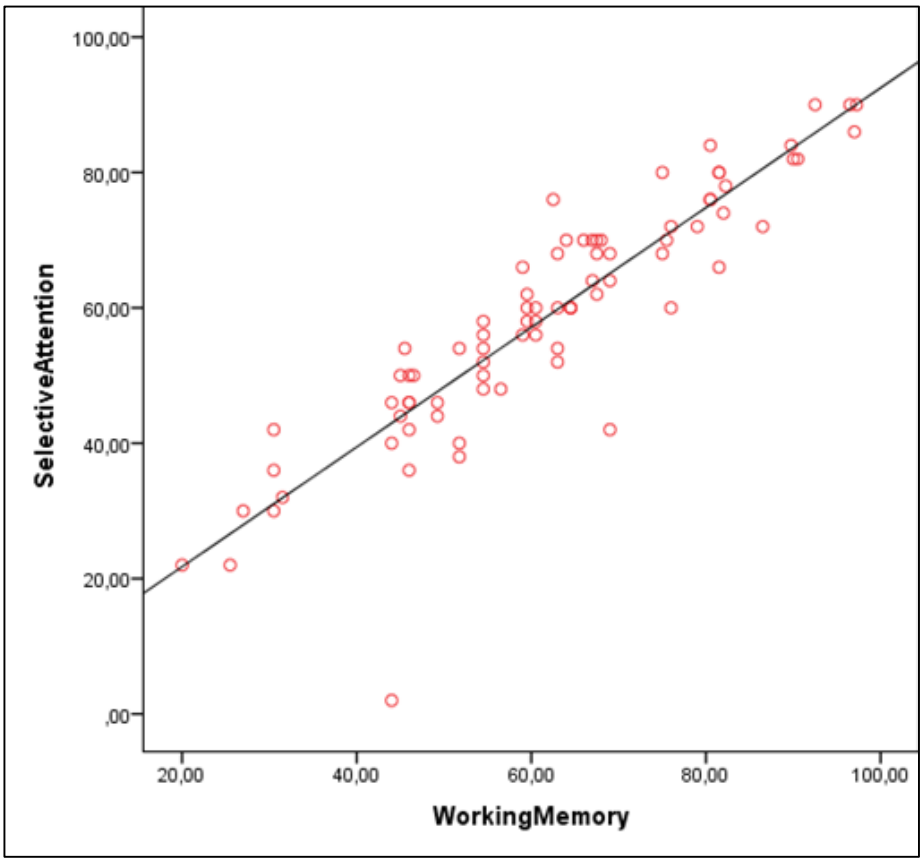

Figure 3.19 Working Memory and Selective Attention scores in a scatter Diagram

Using the SPSS software, we calculated the Pearson Correlation Coefficient and obtained a result of ***r = 0.9***. This value indicated a very strong positive correlation between the variables. For a more detailed analysis of the correlation, we created a Scatter Plot diagram, which confirmed the existence of a linear relationship between WM and SA. The created diagram with the scores of both measures is presented above.

The above figure (3.19) presents the participants' scores from the WM and SA measures closely distributed and situated. This observation indicates a close interrelationship,

which after the calculation of the Pearson's coefficient was confirmed to be strong positive correlation.

Those results indicate that, Yes, the correlation between "Working Memory" and "Selective Attention" is statistically significant and appears to be a strong positive correlation ***r(80) = 0.9***. Therefore, the first null hypothesis was rejected and the second alternative one was confirmed. In other words, and in answer to the research first question, working memory and selective attention share a significant correlation.

The confirmation of the alternative hypothesis supports many researchers' view about the relationship between WM and SA and their influence on perception (Cowan 1998; De Fockert, 2001; Gazzaley & Nobre, 2012). (C.f. chapter 1.2.3)

The research second question asked to what extent WM and SA effect Language learning and comprehension. The following suggested hypotheses was presented to guide the researcher.

- Hypothesis one: Both of WM and SA play a crucial role in Language Processing.

Although this question may appear arbitrary, it actually is critical for the notion of Language Processing. In the multi-components model by Baddeley (c.f. chapter 1.2.2.3), one of the most emphasized ideas is the role of the "Phonological Loop" (c.f. 1.2.2.3.1). It was argued that the loop plays a significant role in language acquisition (Baddeley et al, 1998). During the current study tests, specifically during the WM administered measures participants attempted to learn new items (vocabulary), which adds evidence to the research on the role of WM on language acquisition.

The WM capacity is measured in second language studies to investigate working memory relevance in language learning, it is tested according to its component that is the stress is on the phonological and the executive working memory as the two components that are responsible for language learning (Wen, 2012, p. 04). Based on this claim, the researcher created an online-customized test to measure WM relevance in language learning.

The participants in this study took the RSPAN task, which was adapted from previous works (Elmechta, 2016). Along with two tests passed through the website using a device: Word Span and Letter Sequencing Task. The scores indicated that the harder/longer the stimulus was, subjects tend to recall it slower, forget or recall the stimuli unordered. This observation not only proves the theory of the limited capacity of WM, but also proves the impact of working memory on new vocabulary learning and language learning in general.

The analysis of individuals' differences suggests that SA ability varies from one person to another, subjects who were unable to recall the passage in the dichotic listening task (2), could not answer the questions, which are related to it. This leads to SA being a critical element in language processing and learning. Listening is one of the language skills and unless an individual is concentrating on a given information, the brain is not able to perceive process, manipulate and recall it later.

Although correlations between WM and language and between SA and language were not investigated, the observation of the participants' performance led to the apparent role of cognitive function on Language Learning and Comprehension. This research revealed how effective are working memory and selective attention on an individual's ability to learn and comprehend a foreign language.

The findings in this study suggest that individuals' differences among working memory and selective attention capacities influence learning a language. These results add evidence to the hypotheses being confirmed and proved.

3.7.2. Interpretation and Overall Results

There is broad agreement that language learning is influenced by an assortment of factors in which cognition plays a crucial role. One of the most important views about brain function in general and language processing in particular comes from cognitive psychology. The current study investigated two of the main cognitive factors contributing to the second language learning process. The first studied cognitive function was "Working Memory (WM)" which generally refers to the kind of memory system(s) that allows us to maintain and manipulate a very small amount of information in our head when we are carrying out some cognitive tasks in daily life, such as language comprehension, arithmetic calculation, reasoning and problem solving (Baddeley, 2010). A large body of research have been provided over the last years concerning the conception of WM and its relation to language acquisition. Moving to the second function "Selective Attention (SA)" which is defined as the ability to selectively attend or focus on one stimuli and neglect the others.

The major purpose behind this investigation is to testify whether the two cognitive functions (WM & SA) are correlated; and to what extent they influence the foreign language learning. Unlike the standard tests used to measure the capacities of these functions, we created our own designed test in a form of a website named "Working Memory Test". The language in the present research is a central effective aspect and under the aim to obtain valid, reliable and logic results, we created the tests to assess language processing particularly by providing stimulus in a form of words and sentences. Another objective of the research is to examine the

relationship between WM and SA among individuals. Accomplishing the research objectives requires answering the mean research questions:

- Is there a statistical significant correlation between working memory and selective attention?
- To what extent does working memory and selective attention effect the language learning and comprehension?

In an attempt to answer the first research question, working memory and selective attention tests were described, administered and analyzed. The tests were passed during May 2022 among A1 level learners from private institutes: "Star net, Rihi and Skyline" at Tiaret. Referring to the collected data and obtained scores from all measures, it can be noticeable that the scores of WM tests were almost identical to those of SA tests. Using the Pearson Product Moment Coefficient of Correlation to measure the degree of association between the two variables confirmed our hypothesis about the existence of a statistical correlation between working memory and selective attention.

The results lend a great deal of support to the theories stating that Working Memory and Selective Attention interact with each other and share similar neural mechanisms. (Cowan, 1998)

The calculated mean concerning working memory total scores (M = 61.98) with almost 97.25% of the population reaching the fifth task (five items to recall) supports the theory of capacity limit which declared the WM capacity of four 4 (±1), with a suggestion to modify it to become 4 (±2). The magical number four (4) may reflect a common situation in which information are rapidly recalled and manipulated if necessary. This investigation proved Cowan's view concerning working memory capacity (WMC) and explained the evidence for the capacity limit theory. (Cowan, 2001)

The most general conclusion for the obtained results and in relation to the research first stated problem is that the distinction between working memory and selective attention in previous researches is proved baseless and unreliable. Contradictorily, it supports Cowan's (1995, 1999, 2001) preposition of a close relationship between attention and WM.

Rensink (2000; 2002) offered as well a theory on the necessity of attention for WM, in which he indicated that representations formed by different parts of the brain are impossible to be produced unless attended to.

In an effort to answer the second research question, we evaluated the development of the obtained scores throughout the tests. Although correlations between working memory, selective attention and language were not maintained or investigated, the observation of the participants' performance revealed that the longer the stimulus is the harder the recalling was. The scores from the online test on the website "Working Memory Test" show the more items appear on the screen the less the examinees were able to fulfill the tasks. These scores decrease from one task to another indicating a decreasing working memory capacity as well.

As further evidence, the findings of the last administered measure "Dichotic Listening Task" has shown that the role of attention for the perception of language, which is represented through the recorded passages, is of a great effect. The subjects when exposed to distractive inputs were unable to focus on the passages; therefore, unable to answer the questions related to them.

Attending to a message aside from its characteristics requires the use of a selective factor that filters the inputs in the sensory memory. The role of Attention in the perception of language idea is an agreement among the psychologists. However, the present work along with the obtained scores of the DLT test confirmed the Selective Attention as an active process

responsible of the effective orientation of information into the sensory memory, therefore the other brain stores and areas.

Similar to what we have suggested in the very beginning of this investigation, working memory and selective attention play an important role in the process of Language Learning and Comprehension. However, further research is needed to fully understand the role of WM and SA on Language Proficiency.

Like it was hypothesized in the start of the present research, the ability to perceive information selectively (selective attention) and recall it after it was stored and accessed to (working memory) have a powerful influence on the process of learning a foreign language.

To answer the second research question about the role of working memory and selective attention on language learning and comprehension. This research revealed regarding individuals' differences in working memory capacity and selective attention ability how effective they both are for language processing.

The analysis of the statistical data proved that working memory and selective attention share a strong positive correlation (according to Pearson's Correlation Coefficient). It also confirmed the central critical role of both working memory and selective attention on language learning and comprehension.

3.8. Conclusion

This chapter is devoted to the statistical analysis of the obtained results and findings from the administered tests regarding the capacity of working memory and selective attention. It introduced the data collection methods and procedures along with the scores obtained discussed in tables and graphs.

The first step was to discuss the results obtained from the five administered tests, then we provided a details distribution of scores. The results referred to the theories discussed in the first chapter and confirmed view provided by researchers and scientists in the field of cognitive psychology.

Despite the observed differences of WMC & SAC among individuals and their variation concerning language proficiency, the analysis of the scores and the correlational investigation confirmed the existence of a strong positive correlation between Working Memory and Selective Attention. Additionally, while WM and SA were found to interact effectively, they both have a role and an effect on the learning of a Foreign Language considering that the information processing demands the selection and the memorization of stimuli when entered to the sensory memory.

General Conclusion and Recommendation

1. **Limitation of the current study**
2. **Recommendations**
3. **Suggestions for future investigations**
4. **General Conclusion**
5. **Summary**

1. Limitations

Having developed the issue of cognitive functions in Language Processing and investigating the role of working memory and selective attention on acquiring knowledge, this study was carefully planned and executed despite it suffered like any work of research many limitations to validity. Concerning the literature review, the numerous theories and the breadth of the domain made the process of reviewing theories harder since we were at the risk of neglecting important and point-changing views.

As for data collection, one year is never sufficient in designing a test, checking its reliability, outlining the different contents and stimuli along with planning it to be fit the research's context. It would have included more tests/subtests to assess WMC and SAC, and an expended list of choices for the items of stimuli if we had more time.

While both working memory and selective attention were measured, the language proficiency was not and this can lead to the existence of various differences in cognitive and linguistic abilities. In addition to the small number of participants which can present obstacles for the generalization.

During the process of data analysis, if the tests of measuring were standardized, the results will appear more precisely.

In the face of all the drawbacks, the current research conducted an original topic with the use of an original self-designed online test "Working Memory Test" and created a new tool of data collection for future researches. We presented different data analysis methods and we closed with reliable valid results.

2. Recommendations

This study's results confirmed the existence of a significant statistical relationship between two different cognitive functions/abilities, which might be of valuable impact on the field of cognitive psychology and Neurolinguistics.

We would highly recommend the following points:

- The implementation of the "Working Memory Test" in Cognitive Psychology related studies.
- Conduct multiple analysis including other variables/sub variables such as:
  - Divided Attention
  - Short(term Memory
  - Long-term Memory
  - Intelligence
  - Reasoning and Thinking
  - Language Attitude
- Teachers are recommended to use and integrate cognitive abilities anf focus on them rather than real life goals and simple mental abilities for a better language processing.
- Duplicate this study, but collect data at different time for more reliable results.
- Duplicate this study, and pick a wider pilot study sample to assess the reliability of the measuring tests and methods.
- Teachers should present vocabulary to learners with the use of different strategies such as the use of pictures and recorded audios to help the processing of information in the different areas of brain and develop the working memory capacity.

Having provided both the limitations and recommendation for the current study, and highlighted the main gaps and drawbacks along with the possible uses of the created tools and obtained results, future researchers could make use of the following suggestion.

3. Suggestions for Future Studies

Researchers can now say much more about the language processing rather than the acquisition of new vocabulary and terms, future researches can rely on the strong positive correlation between the working memory and selective attention to conduct researches on their effect on other cognitive functions.

Moreover, a new test is created for the working memory capacity (WMC) measure, which can be used to assess learners WMC in L1 learning, daily life tasks and problem solving.

The present research opened doors for several studies to be explored in the future. It is an attempt to revive the use of technology in language learning and computer based abilities/capacities testing techniques. The current research is a shift from paper-and-pencil cognitive abilities tests to online tests. It would optimistically be a valuable and serviceable instrument in both of Foreign Language learning and Cognitive Psychology fields.

General Conclusion

Neurolinguistics studies have always emphasized on how language functions in the human brain. “Working Memory” and “Selective Attention” have been the object of constant experimental and theoretical studies for decades long. Viewing that learning a language is an active process that requires attending to and understanding the given ideas/information; the present study was conducted to find the correlation between both working memory and selective attention along with their effects as cognitive functions on language learning and comprehension. The sample was A1 level learners at private institutes in Tiaret.

To go through the different views concerning the research variables and their development over the last years, the first chapter was dedicated to the historical background and different theories and models related to them. The second chapter followed presenting the data collection and different measurements used. We sought to create an online webpage concerned with the working memory capacity and different subtests for its measure. The website “Working Memory Test” is originally uniquely created for the current research.

In addition to improving instrumentation and obtaining valid reliable results, the test will be a good addition to future researches and an inclusion in the field of cognitive psychology field.

Alongside with the subtests from the website, the reading span was another test for working memory measure. On the other hand, selective attention was also assessed and measured using the “Dichotic listening Task”. Fortunately the obtained results from the set of tests administered revealed a strong positive correlation between the research variables and proved that they interact on a high level explicitly when learning new information or confronting a complex task. Furthermore, both of working memory and selective attention have been proved to have a central role in language processing since individuals related on their

ability to hold, manipulate and process the information, which is originally the title role of these latters.

As a final point, since the analysis of the correlation between the research variables produced very close results to those presented on previous researches and models; the study proved that there is more than only acquiring and understanding language. The path that information takes in the human brain and the stores it passes through is a worth studying and investigating point.

From what has been selected, studied and analyzed, it appears that working memory and selective attention are two related cognitive functions and that they both took an essential part in the processing and the comprehending of foreign language.

References

- Alloway, T. P., & Alloway, R. G. (2013). Working memory across the lifespan: A cross-sectional approach. Journal of Cognitive Psychology, 25(1), 84-93.
- Andrade, M., & Walker, N. (2020, May 17). *11.2: History of Attention*. Social Sci LibreTexts. https://socialsci.libretexts.org/Bookshelves/Psychology/Cognitive_Psychology_(Andrade_and_Walker)/11%3A_Attention/11.02%3A_History_of_Attention
- Archibald, L. M. D., Levee, T., & Olino, T. (2015). Attention allocation: Relationships to general working memory or specific language processing. *Journal of Experimental Child Psychology*, *139*, 83–98. https://doi.org/10.1016/j.jecp.2015.06.002
- Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In Psychology of learning and motivation (Vol. 2, pp. 89-195). Academic Press.
- Atkinson, R. C., & Shiffrin, R. M. (1971). The control of short-term memory. Scientific american, 225(2), 82-91.
- Baddeley, A. (1998). The central executive: A concept and some misconceptions. Journal of the International Neuropsychological Society, 4(5), 523-526.
- Baddeley, A. (2000). The episodic buffer: a new component of working memory?. Trends in cognitive sciences, 4(11), 417-423.
- Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences*, *4*(11), 417–423. https://doi.org/10.1016/s1364-6613(00)01538-2

- Baddeley, A. (2001). The magic number and the episodic buffer. *Behavioral and Brain Sciences*, *24*(1), 117-118.
- Baddeley, A. (2003). Working memory and language: an overview. *Journal of Communication Disorders*, *36*(3), 189–208. https://doi.org/10.1016/s0021-9924(03)00019-4
- Baddeley, A. (2010). Working memory. Current biology, 20(4), R136-R140.
- Baddeley, A. D. (1978). The trouble with levels: A reexamination of Craik and Lockhart's framework for memory research.
- Baddeley, A. D. (1983). Working memory. Philosophical Transactions of the Royal Society of London. B, Biological Sciences, 302(1110), 311-324.
- Baddeley, A. D. (2017). Exploring the central executive. In Exploring Working Memory (pp. 253-279). Routledge.
- Baddeley, A. D., Hitch, G. J., & Allen, R. J. (2019). From short-term store to multicomponent working memory: The role of the modal model. Memory & cognition, 47(4), 575-588.
- Baddeley, A., & Hitch, G. J. (1974). Working memory. In G. A. Bower (Ed.), *Recent Advances in Learning and Motivation* (Vol. 8, pp. 47-90). Academic Press.
- Baddeley, A.D., Gathercole, S.E. and Papagno, C. (1998) The phonological loop as a language learning device. Psychological Review 105, 158–173.
- Bailey, H., Dunlosky, J., & Kane, M. J. (2008). Why does working memory span predict complex cognition? Testing the strategy affordance hypothesis. Memory & Cognition, 36(8), 1383-1390.
- Bottleneck Theory. (n.d.). In Alleydog.com's online glossary. Retrieved from: https://www.alleydog.com/glossary/definition-cit.php?term=Bottleneck+Theory
- Broadbent, D. E. (1958). The selective nature of learning.

- Broadbent, D. E. (1982). Task combination and selective intake of information. Acta psychologica, 50(3), 253-290.
- Broadbent, D. E. (1982). Task combination and selective intake of information. Acta psychologica, 50(3), 253-290.
- Broadbent, D. E. (2013). Perception and communication. Elsevier.
- Brown, G. D. (1992). Cognitive psychology and second language processing: The role of short-term memory. In Advances in psychology (Vol. 83, pp. 105-121). North-Holland.
- Carroll, D. W. (1986). Psychology of language. Thomson Brooks/Cole Publishing Co.
- Chang, Y. C., Guo, N. W., Wang, S. T., Huang, C. C., & Tsai, J. J. (2001). Working memory of school-aged children with a history of febrile convulsions: a population study. Neurology, 57(1), 37-42.
- Chomsky, N. (2000). The architecture of language.
- Colliflower, T. J. (2013). Interpretation of the WISC-IV working memory index as a measure of attention.
- Collins, L. M., & Horn, J. L. (1991). Best methods for the analysis of change: Recent advances, unanswered questions, future directions. American Psychological Association.
- Conway, A. R. (1996). Individual differences in working memory capacity: More evidence for a general capacity theory. Memory, 4(6), 577-590.
- Conway, A. R., Cowan, N., & Bunting, M. F. (2001). The cocktail party phenomenon revisited: The importance of working memory capacity. Psychonomic bulletin & review, 8(2), 331-335.
- Conway, A. R., Kane, M. J., & Engle, R. W. (2003). Working memory capacity and its relation to general intelligence. Trends in cognitive sciences, 7(12), 547-552.

- Cowan, N. (2005). Working memory capacity limits in a theoretical context. In Human learning and memory: Advances in theory and application. The 4th Tsukuba international conference on memory (pp. 155-175). Mahwah, NJ: Erlbaum.
- Cowan, N. (2010). The magical mystery four: How is working memory capacity limited, and why?. Current directions in psychological science, 19(1), 51-57.
- Cowan, N. (2012). Working memory capacity. Psychology press.
- Cowan, N., Morey, C. C., Chen, Z., Gilchrist, A. L., & Saults, J. S. (2008). Theory and measurement of working memory capacity limits. Psychology of Learning and Motivation, 49, 49-104.
- Cowan, N., Morey, C. C., Chen, Z., Gilchrist, A. L., & Saults, J. S. (2008, January 1). *Theory and Measurement of Working Memory Capacity Limits* (B. H. Ross, Ed.). ScienceDirect; Academic Press. https://www.sciencedirect.com/science/article/pii/S0079742108000029
- Craik, F. I. (2002). Levels of processing: Past, present... and future?. Memory, 10(5-6), 305-318.
- Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of verbal learning and verbal behavior, 11(6), 671-684.
- Craik, F. I., & Lockhart, R. S. (1996). Models of Memory. In Introducing Psychological Research (pp. 310-316). Palgrave, London.
- Craik, F. I., & Lockhart, R. S. (1996). Models of Memory. In Introducing Psychological Research (pp. 310-316). Palgrave, London.
- Craik, F. I., & Watkins, M. J. (1973). The role of rehearsal in short-term memory. Journal of verbal learning and verbal behavior, 12(6), 599-607.
- Daneman, M. & Carpenter, P. 19, 46, 64, 78, 111, 129, 131–132, 161, 167, 184, 186, 209, 273, 287, 294

- Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. Journal of verbal learning and verbal behavior, 19(4), 450-466.
- de Fockert, J. W., Rees, G., Frith, C. D., & Lavie, N. (2001). The role of working memory in visual selective attention. Science, 291(5509), 1803-1806.
- DeKeyser, R. (Ed.). (2007). Practice in a second language: Perspectives from applied linguistics and cognitive psychology. Cambridge University Press.
- Egeth, H. (1967). Selective attention. Psychological Bulletin, 67(1), 41.
- ELMECHTA, L. (2015). The Implementation of a Linguistic Ability Test as a Selection Basis in Learning English as a Foreign Language. Arab World English Journal.
- Elmechta, L. (2016). *The Impact of Language Aptitude, Working Memory and Verbal Reasoning as Aspects of Linguistic Intelligence on Language Learning Achievement* [PhD Thesis]. http://193.194.84.142/theses/anglais/ELM1425.pdf
- Engle, R. W. (2001). What is working memory capacity?.
- Ferreira, F. (2005). Psycholinguistics, formal grammars, and cognitive science.
- Fougnie, D. (2008). *The Relationship between Attention and Working Memory*. http://www.psy.vanderbilt.edu/students/fougnidl/Fougnie-chap1.pdf
- Friederici, A. D., Chomsky, N., Berwick, R. C., Moro, A., & Bolhuis, J. J. (2017). Language, mind and brain. Nature human behaviour, 1(10), 713-722.
- Galton, F. (1948). Inquiries into human faculty and its development, 1883.
- Gruber, O., & Goschke, T. (2004). Executive control emerging from dynamic interactions between brain systems mediating language, working memory and attentional processes. *Acta Psychologica*, *115*(2-3), 105–121. https://doi.org/10.1016/j.actpsy.2003.12.003

- Huitt, W. (2003). The information processing approach to cognition. Educational psychology interactive, 3(2), 53.
- Izawa, C. (Ed.). (1999). On human memory: Evolution, progress, and reflections on the 30th anniversary of the Atkinson-Shiffrin model. Psychology Press.
- James, W., Burkhardt, F., Bowers, F., & Skrupskelis, I. K. (1890). The principles of psychology (Vol. 1, No. 2). London: Macmillan.
- Kahneman, D. (1973). Attention and effort (Vol. 1063, pp. 218-226). Englewood Cliffs, NJ: Prentice-Hall.
- Kane, M. J., Bleckley, M. K., Conway, A. R., & Engle, R. W. (2001). A controlled-attention view of working-memory capacity. Journal of experimental psychology: General, 130(2), 169.
- Kane, M. J., Conway, A. R., Hambrick, D. Z., & Engle, R. W. (2007). Variation in working memory capacity as variation in executive attention and control. Variation in working memory, 1, 21-48.
- Kraus, T. H. -, & Breznitz, Z. (2009). Can the Error Detection Mechanism Benefit from Training the Working Memory? A Comparison between Dyslexics and Controls — An ERP Study. *PLoS ONE*, *4*(9), e7141. https://doi.org/10.1371/journal.pone.0007141
- Ku Y. (2018). Selective attention on representations in working memory: cognitive and neural mechanisms. PeerJ, 6, e4585. https://doi.org/10.7717/peerj.4585
- Ku, Y. (2018). Selective attention on representations in working memory: cognitive and neural mechanisms. *PeerJ*, *6*(e4585). https://doi.org/10.7717/peerj.4585
- La Pointe, L. B., & Engle, R. W. (1990). Simple and complex word spans as measures of working memory capacity. Journal of Experimental Psychology: Learning, Memory, and Cognition, 16(6), 1118.

- La Pointe, L. B., & Engle, R. W. (1990). Simple and complex word spans as measures of working memory capacity. Journal of Experimental Psychology: Learning, Memory, and Cognition, 16(6), 1118.
- *language noun - Definition, pictures, pronunciation and usage notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com*. (n.d.). Www.oxfordlearnersdictionaries.com. https://www.oxfordlearnersdictionaries.com/definition/english/language
- Luck, S. J., & Vogel, E. K. (2013). Visual working memory capacity: from psychophysics and neurobiology to individual differences. Trends in cognitive sciences, 17(8), 391-400.
- Mambrol, N. (2020, November 7). *Transformational Generative Grammar*. Literary Theory and Criticism. https://literariness.org/2020/11/07/transformational-generative-grammar/
- Marc, G., & Dan, Z. (1991). One more criticism of the multistore model of memory: An experiment on the first-in-first-out (FIFO) principle. The Journal of psychology, 125(4), 497-499.
- Mcleod, S. (2007). *Levels of Processing*. Simplypsychology.org. https://www.simplypsychology.org/levelsofprocessing.html
- Mcleod, S. (2018). *Theories of selective attention*. Simply Psychology. https://www.simplypsychology.org/attention-models.html
- Merriam-Webster. (2019). *Definition of LEARNING*. Merriam-Webster.com. https://www.merriam-webster.com/dictionary/learning
- Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological review, 63(2), 81.

- Miller, G. A., Eugene, G., & Pribram, K. H. (2017). Plans and the Structure of Behaviour. In Systems Research for Behavioral Sciencesystems Research (pp. 369-382). Routledge.
- Miyake, A., & Shah, P. (1997). Models of working memory. COLORADO UNIV AT BOULDER DEPT OF PSYCHOLOGY.
- Miyake, A., & Shah, P. (1997). Models of working memory. COLORADO UNIV AT BOULDER DEPT OF PSYCHOLOGY.
- Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries. Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior, 22(2), 89-106.
- Morey, C. C., & Saults, J. S. Theory and Measurement of Working Memory Capacity Limits.
- Newell, A., & Simon, H. (1956). The logic theory machine--A complex information processing system. IRE Transactions on information theory, 2(3), 61-79.
- Newell, A., & Simon, H. A. (1972). *Human problem solving* (Vol. 104, No. 9). Englewood Cliffs, NJ: Prentice-hall.
- Oberauer, K. (2019). Working Memory and Attention – A Conceptual Analysis and Review. *Journal of Cognition*, *2*(1). https://doi.org/10.5334/joc.58
- Obler, L. K., & Gjerlow, K. (1999). Language and the Brain. Cambridge University Press.
- Pashler, H. (1984). Processing stages in overlapping tasks: evidence for a central bottleneck. Journal of Experimental Psychology: Human perception and performance, 10(3), 358.

- Perlovsky, L., & Sakai, K. L. (2014). Language and Cognition. *Frontiers in Behavioral Neuroscience*, *8*. https://doi.org/10.3389/fnbeh.2014.00436
- *Processes of word recognition in a second language*. (n.d.).
- Randall, M. (2007). *Memory, Psychology and Second Language Learning* (Vol. 19). John Benjamins. (Original work published 1946)
- Redick, T. S., Broadway, J. M., Meier, M. E., Kuriakose, P. S., Unsworth, N., Kane, M. J., & Engle, R. W. (2012). Measuring working memory capacity with automated complex span tasks. European Journal of Psychological Assessment, 28(3), 164.
- References
- Rensink, R. A. (2000). Visual search for change: A probe into the nature of attentional processing. Visual cognition, 7(1-3), 345-376.
- Repovš, G., & Baddeley, A. (2006). The multi-component model of working memory: Explorations in experimental cognitive psychology. Neuroscience, 139(1), 5-21.
- Schroeder, S. R., & Marian, V. (2012). A bilingual advantage for episodic memory in older adults. Journal of Cognitive Psychology, 24(5), 591-601.
- Shallice, T., & Warrington, E. K. (1970). Independent functioning of verbal memory stores: A neuropsychological study. The Quarterly journal of experimental psychology, 22(2), 261-273.
- Skinner, B. F. (1950). Are theories of learning necessary?. Psychological review, 57(4), 193.
- STROOP, J. R. (1991). Journal of Experimental Psychology by John Ridley Stroop (Stroop, 1935a). Since that time. Canadian Psychology/Psychologie canadienne, 32(3), 521.
- Theeuwes, J. (1993). Visual selective attention: A theoretical analysis. Acta psychologica, 83(2), 93-154.

- Treisman, A. M. (1964). Selective attention in man. British medical bulletin, 20(1), 12-16.
- Unsworth, N., Schrock, J. C., & Engle, R. W. (2004). Working memory capacity and the antisaccade task: individual differences in voluntary saccade control. Journal of Experimental Psychology: Learning, Memory, and Cognition, 30(6), 1302.
- Wen, Z. (2012). Working memory and second language learning. International Journal of Applied Linguistics, 22(1), 1-22.

Appendices

Appendix 01: The Reading Span task

Read aloud the following sentences and recall the last word in every sentence

Task 01:

a. The girl bought a dress.

b. The mechanic fixed the broken car.

Task 02:

a. Our family inherited a big house in Algiers.

b. Our people are fascinated with romantic series than scientific documentaries.

c. The girl was dissatisfied with the dress she bought yesterday.

Task 03:

a. The station is crowded with people going away.

b. The candles started the fire.

c. The child enjoyed the hot chocolate.

d. We like horror movies better than action movies.

Task 04:

a. The girl was pleased with the bracelet. B

b. I polish the furniture every weekend. R

c. The lines guided the swimmer. Y

d. The gangsters attacked the store. X

Task 05:

a. The play will start in few minutes.

b. Our house was filled with quests.

c. The football game was amazing.

d. I cannot read what you have written.

e. The bomb killed fifty people.

Task 06:

a. It was the psychologist who scored the test.

b. It was the ship that transported the food.

c. It was the bone that the dog fetched.

d. It was the gangster who attacked the store.

e. It was the woman that the gift delighted.

f. It was the telephone that woke up the tired girl.

Task 07:

a. It was the candles that started the fire. Q

b. It was the girl that nourished the milk. P

c. It was the hot chocolate that enjoyed the child. U

d. It was the dollhouse that amazed the baby. B

e. It was the furniture that polished the wife. E

f. It was the policeman that provoked the gun. L

Task 08:

a. It was the heat that melts the ice.

b. It was the passengers that hold the bus.

c. It was the professor that scored the test.

d. It was the swimmer that guided the lines.

e. It was the bracelet that pleased the wife.

f. It was the DJ that broke the tape.

g. It was the test that takes the students.

Task 09:

a. It was the painting that inspired us.

b. It was the policeman that provoked the gun.

c. It was the mirror that excited the cat.

d. It was the man that annoyed the light.

e. It was the inspector that rejected the place.

f. It was the mess that bothered the cleaner.

g. It was the elephant that knocked over the gate.

h. It was the ocean that swallowed up the boat.

Appendix 02: The Dichotic Listening Task passages

Passage 01:

Mr. Harris liked trains. He was afraid of airplanes, and didn't like buses. But trains — they were big and noisy and exciting. When he was a boy of ten, he liked trains. Now he was a man of fifty, and he still liked trains.

So he was a happy man on the night of the 14th of September. He was on the night train from Helsinki to Oulu in Finland, and he had ten hours in front of him. "I've got a book and my newspaper," he thought. "And there's a good restaurant on the train. And then I've got two weeks' holiday with my Finnish friends in Oulu".

There weren't many people on the train, and nobody came into Mr. Harris's carriage. He was happy about that. Most people on the train slept through the night, but Mr. Harris liked to look out of the window, and to read and think.

After dinner in the restaurant Mr. Harris came back to his carriage, and sat in his seat next to the window. For an hour or two, he watched the trees and lakes of Finland out of the window. Then it began to get dark, so he opened his book and began to read. At midnight the train stopped at the small station of Otava. Mr. Harris looked out of the window, but he saw nobody. The train moved away from the station, into the black night again. Then the door of Mr. Harris's carriage opened, and two people came in. A young man and a young woman.

The young woman was angry. She closed the door and shouted at the man: 'Carl! You can't do this to me!' The young man laughed loudly and sat down.

Passage 02:

My name is John Grogan and I love dogs. When I was ten years old, my father gave me my first dog. I called him Shaun. Shaun was my best friend. He went everywhere with me and he was very obedient. When I called him, he came to me. He played with me and he walked next to me without a leash. In the car, he sat next to me quietly.

After many years, Shaun died. He was fourteen years old. By that time, I wasn't a boy; I was a man. I had my first job. Shaun was a great dog. I wanted to get another dog, but it had to be as wonderful as Shaun. Some years later, I moved to Florida and married Jenny. Jenny and I had jobs with newspapers. We were very happy. We were young and in love, and life was wonderful. One day, I bought a plant for Jenny. It was very large, with beautiful white flowers. Jenny loved it — maybe too much. Every day, she gave it water. In the end, the plant got sick and died. Some days later, I woke up early. Jenny wasn't in bed. I found her at the table with a newspaper. She had a red pen in her hand.

«Jenny, » I said, «what are you doing? » She showed me the newspaper. It was open at a page of ads. «Look at this, John, » she said: "I saw an ad with a big red line under it: Beautiful Labrador puppies. Five weeks old. «I can't forget about that plant, » Jenny said. «Why couldn't I look after a plant? I only had to give it water, but I killed it. » She looked sad, but then she smiled. «I can't look after a plant, but maybe I can look after a dog. In addition, later, maybe I will be ready for a baby.

Appendix 03: The Web site sub-tests

The web site “Working Memory Test” was designed based on the instructions explained in the handed flyer

Appendix 04: The Reading Span Pilot Test

Read aloud the following sentences and recall the last word in every sentence

Task 01:

a. We eat soup with a spoon.
b. On my birthday cake, I blew out the candles.

Task 02:

a. To get a haircut, we go to the hairdresser

b. Wash your hands with soap and water.

c. When one sees badly, one must wear glasses.

Task 03:

a. The station is crowded with people going away.

b. The candles started the fire.

c. The child enjoyed the hot chocolate.

d. We like horror movies better than action movies.

Task 04:

a. The girl was pleased with the bracelet. B

b. I polish the furniture every weekend. R

c. The lines guided the swimmer. Y

d. The gangsters attacked the store. X

Task 05:

a. The play will start in few minutes.

b. Our house was filled with quests.

c. The football game was amazing.

d. I cannot read what you have written.

e. The bomb killed fifty people.

Task 06:

a. It was the psychologist who scored the test.

b. It was the ship that transported the food.

c. It was the bone that the dog fetched.

d. It was the gangster who attacked the store.

e. It was the woman that the gift delighted.

f. It was the telephone that woke up the tired girl.

Task 07:

a. It was the candles that started the fire. Q

b. It was the girl that nourished the milk. P

c. It was the hot chocolate that enjoyed the child. U

d. It was the dollhouse that amazed the baby. B

e. It was the furniture that polished the wife. E

f. It was the policeman that provoked the gun. L

Task 08:

a. It was the heat that melts the ice.

b. It was the passengers that hold the bus.

c. It was the professor that scored the test.

d. It was the swimmer that guided the lines.

e. It was the bracelet that pleased the wife.

f. It was the DJ that broke the tape.

g. It was the test that takes the students.

Task 09:

a. It was the painting that inspired us.

b. It was the policeman that provoked the gun.

c. It was the mirror that excited the cat.

d. It was the man that annoyed the light.

e. It was the inspector that rejected the place.

f. It was the mess that bothered the cleaner.

g. It was the elephant that knocked over the gate.

h. It was the ocean that swallowed up the boat.

Appendix 05: The Dichotic Listening Task Pilot Test

1) At the pool you learn to swim.

2) In tennis, we send the ball with a racket.

3) I put a record to listen to music.

4) When there is fire, the fire department is called.

5) In a haunted castle, there are ghosts.

6) We go to school to learn to read and write.

7) At the supermarket, we go to the cashier to pay.

8) The mistress writes with a chalk on the board.

9) To know the time, I look on my watch.

10) The plates are dirty, I have to do the dishes.

Appendix 06: Working Memory Tests Scores

Participants	Total score (/100)	Percentage (%)	Word Span Score (/ 30)	Letter Sequencing (/30)	RSPAN (/40)
1	68	68 %	15	19,5	33,5
2	30,5	30,5 %	7,5	11	12
3	44	44 %	15	19,5	9,5
4	30,5	30,5 %	7 ,5	11	12
5	60,5	60,5 %	11	19,5	30
6	64 ,5	64 ,5 %	15	19,5	30
7	67	67 %	19,5	19,5	28
8	86,5	86,5 %	24,5	30	32
9	46	46 %	11	15	20
10	59,5	59,5 %	15	24,5	20
11	44	44 %	15	19 ,5	9,5
12	31,5	31,5 %	11	11	9,5
13	69	69 %	24,5	24,5	20
14	82,25	82,25 %	24,5	24,5	33,25
15	97,25	97,25 %	30	30	37,25
16	45	45 %	15	15	15
17	46	46 %	11	15	20
18	46	46 %	15	11	20
19	54,5	54,5 %	15	19,5	20
20	67,5	67,5 %	15	19,5	33
21	64	64 %	24,5	24,5	15
22	49,25	49,25 %	11	15	23,25
23	25,5	25,5 %	11	11	3,5
24	81,5	81,5 %	30	24,5	27
25	67,5	67,5 %	24,5	19,5	23,5

26	90,5	90,5 %	24,5	30	36,5
27	63	63 %	19,5	19,5	24
28	51,75	51,75 %	15	15	21,75
29	54,5	54,5 %	19,5	15	20
30	59	59 %	19,5	19,5	20
31	75	75 %	24,5	19,5	31
32	97	97 %	30	30	37
33	76	76 %	24,5	19,5	32
34	69	69 %	19,5	19,5	30
35	46	46 %	15	11	20
36	81,5	81,5 %	24,5	24,5	32,5
37	80,5	80,5 %	30	24,5	26
38	66	66 %	24,5	15	33,5
39	81,5	81,5 %	30	24 ,5	27
40	45,5	45,5 %	11	19,5	15
41	51,75	51,75 %	15	15	21,75
42	69	69 %	19,5	19,5	30
43	75	75 %	24,5	19,5	31
44	92,5	92,5 %	24,5	30	38
45	90	90 %	24,5	30	35,5
46	62,5	62,5 %	11	15	36,5
47	54,5	54,5 %	19,5	15	20
48	63	63 %	19,5	19,5	24
49	89,75	89,75 %	24,5	30	35,25
50	45	45 %	15	15	15
51	54 ,5	54 ,5 %	19,5	15	20
52	60,5	60,5 %	11	19,5	30
53	67	67 %	19,5	19,5	28
54	82	82 %	24,5	24,5	33

55	67,5	67,5 %	24,5	19,5	23,5
56	56,5	56,5 %	11	24,5	21
57	54,5	54,5 %	19,5	15	20
58	59	59 %	19,5	19,5	20
59	75,5	75,5 %	19,5	19,5	36,5
60	96,5	96,5 %	30	30	36,5
61	63	63 %	19,5	19,5	24
62	46,5	46,5 %	15	19,5	12
63	27	27 %	7,5	7,5	12
64	46	46 %	11	15	20
65	54,5	54,5 %	15	19,5	20
66	79	79 %	19,5	24,5	35
67	59,5	59,5 %	15	24,5	20
68	59,5	59,5 %	15	24,5	20
69	64,5	64,5 %	15	19,5	30
70	20	20 %	7,5	7,5	5,5
71	49,25	49,25 %	11	15	23,25
72	60,5	60,5 %	11	19,5	30
73	44	44 %	15	19,5	9,5
74	80,5	80,5 %	30	24,5	26
75	30,5	30,5 %	7,5	11	12
76	80,5	80,5 %	30	24,5	26
77	64,5	64,5 %	15	19,5	30
78	63	63 %	19,5	19,5	24
79	51,75	51,75 %	15	15	21,75
80	76	76 %	24,5	19,5	30
Sum			1464	1563	1929,5

Appendix 07: Letter Sequencing Sub-test results

The results from the web site were saved in the following form:

Letter Sequencing Task Scores (/30)
19,5
11
19,5
11
19,5
19,5
19,5
30
15
24,5
19 ,5
11
24,5
24,5
30
15
15
11
19,5
19,5
24,5
15
11
24,5
19,5

30
19,5
15
15
19,5
19,5
30
19,5
19,5
11
24,5
24,5
15
24 ,5
19,5
15
19,5
19,5
30
30
15
15
19,5
30
15
15
19,5
19,5
24,5

19,5
24,5
15
19,5
19,5
30
19,5
19,5
7,5
15
19,5
24,5
24,5
24,5
19,5
7,5
15
19,5
19,5
24,5
11
24,5
19,5
19,5
15
19,5

Appendix 08: The Dichotic Listening Task testing the headphones

While the participants were getting reading for the last administered task, which was the DLT, the researcher along with the organizers tested the functionality of the headphones using the following sentences to check whether the subjects were able to hear clearly the delivered messages.

1) To get up on time in the morning, I put an alarm clock

2) A man is big, a child is small.

3) We eat with a fork and a knife.

4) At Christmas, we hang balls on the tree.

Appendix 09: the Dichotic Listening Task Scores

Participants (80)	Total score/100+%	DLT (1) score/50+%	DLT (2) score/50+%
1	70=70%	50=100%	20=40%
2	42=42%	30=60%	12=24%
3	42=42%	28=56%	14=28%
4	30=30%	30=60%	00=00%
5	60=60%	46=92%	14=28%
6	60=60%	46=92%	14=28%
7	64=64%	50=100%	14=28%
8	72=72%	50=100%	22=44%
9	46=46%	28=56%	28=56%
10	58=58%	50=100%	08=16%
11	46=46%	40=80%	06=12%
12	32=32%	28=56%	04=08%
13	68=68%	50=100%	18=36%
14	78=78%	50=100%	28=56%
15	90=90%	50=100%	40=80%
16	50=50%	42=84%	08=16%
17	42=42%	32=64%	10=20%
18	36=36%	36=72%	00=00%
19	50=50%	40=80%	10=20%
20	68=68%	50=100%	18=36%
21	70=70%	50=100%	20=40%
22	46=46%	36=72%	10=20%
23	22=22%	22=44%	00=00%
24	80=80%	50=100%	30=60%
25	70=70%	50=100%	20=40%
26	82=82%	50=100%	32=64%
27	54=54%	46=92%	08=16%
28	40=40%	26=52%	14=28%
29	48=48%	34=68%	14=28%
30	56=56%	42=84%	14=28%
31	68=68%	50=100%	18=36%
32	86=86%	50=100%	36=72%
33	60=60%	46=92%	14=28%
34	42=42%	38=76%	04=08%
35	46=46%	38=76%	08=16%

36	80=80%	50=100%	30=60%
37	76=76%	50=100%	26=52%
38	70=70%	50=100%	20=40%
39	66=66%	44=88%	22=44%
40	54=54%	38=76%	16=32%
41	54=54%	38=76%	16=32%
42	64=64%	40=80%	24=48%
43	80=80%	50=100%	30=60%
44	90=90%	50=100%	40=80%
45	82=82%	50=100%	32=64%
46	76=76%	50=100%	26=52%
47	54=54%	44=88%	10=20%
48	60=60%	50=100%	10=20%
49	84=84%	50=100%	34=68%
50	44=44%	32=64%	12=24%
51	52=52%	30=60%	22=44%
52	58=58%	26=52%	32=64%
53	70=70%	50=100%	20=40%
54	74=74%	50=100%	24=48%
55	62=62%	40=80%	22=44%
56	48=48%	36=72%	12=24%
57	58=58%	46=92%	12=24%
58	66=66%	50=100%	16=32%
59	70=70%	50=100%	20=40%
60	90=90%	50=100%	40=80%
61	68=68%	50=100%	18=36%
62	50=50%	38=76%	12=24%
63	30=30%	30=60%	00=00%
64	50=50%	42=84%	08=16%
65	56=56%	44=88%	12=24%
66	72=72%	50=100%	22=44%
67	60=60%	40=80%	20=40%
68	62=62%	50=100%	12=24%
69	60=60%	34=68%	26=52%
70	22=22%	22=44%	00=00%
71	44=44%	38=76%	06=12%
72	56=56%	40=80%	16=32%
73	40=40%	40=80%	00=00%
74	76=76%	50=100%	26=52%

75	36=36%	34=68%	02=04%
76	84=84%	50=100%	34=68%
77	60=60%	40=80%	22=44%
78	52=52%	42=84%	10=20%
79	38=38%	34=68%	04=08%
80	72=72%	50=100%	22=44%
Mean ($\bar{X}$)	59.30	42.45	16.98

ملخص

يعتمد تعلم لغة اجنبية الى حدّ كبير على مجموعة من الوظائف المعرفية التي تؤثر على عملياتها المختلفة انطلاقا من مرحلة الاكتساب الى فهم واِتْقان اللـغة. يهدف هذا البحث الى إبراز دور كلٍّ منَ "الذاكرة العاملة/النشطة" و "التركيز الاختياري/الانتقائي" في تعلم اللغة وإتقانها، كما يهدف الى تحديد ما إذا كانت هاتان الأخيرتان تتشاركان علاقة عملية وظائفية.

على هذا الأساس افترضنا انّ هناك علاقةً وقمنا بإجراء عدّةِ اختبارات فكرية ومعرفية لقياس قدرة كلّ من الذاكرة النشطة والتركيز الاختياري. تم استخدام موقع ويب مصمم خصيصاً من طرف الباحث لضمان ميثاقية واختلاف النتائج المتحصل عليها، حيث تم إيجاد علاقة قوية وإيجابية ملحوظة بين العاملين وتمّ تأكيد تأثيرهما الفعال في تعلم اللغو وفهمها.

Résumé

L'apprentissage d'une langue étrangère repose dans une large mesure sur une variété de fonctions cognitives affectant ses différentes opérations, passant de niveau d'acquisition au niveau de maitrise de la langue et sa compréhension. Cette recherche vise à mettre en évidence le rôle de la mémoire de travail et l'attention sélective sur l'apprentissage de la langue.

De ce fait, nous avons émis hypothèse qu'il existe une corrélation entre les variables de recherche et nous avons effectué de nombreux tests cognitifs pour mesurer ses capacités. Un site web spécialement crée pas le rechercher a été utilisé pour assurera fiabilité et la des données obtenues. Les résultats montrent qu'il existe une forte corrélation positive entre la mémoire de travail et l'attention sélective et qu'elles ont toutes deux un rôle efficace sur l'apprentissage et la compréhension de la langue étrangère.