

**THE STUDY OF THE REY AUDITORY VERBAL LEARNING
TEST IN THE ELDERLY DEMENTIA PATIENTS**

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OF THE REQUIREMENTS FOR
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ABSTRACT

The objective of this research is to compare the verbal memory abilities of the elderly with dementia and normal elderly using the Rey Auditory Verbal Learning Test (RAVLT).

The sample group consists of 37 elderly out patients with dementia at the Memory Clinic of the Chiang Mai Neurological Hospital and 37 normal elderly people from the Chiang Mai Neurological Hospital Elderly club who had been screened for dementia and depression through the Thai Mental State Examination (TMSE) and the Thai Mental Health Questionnaire (TMHQ). Data is collected using RAVLT to evaluate verbal memory and the results compared using the t-test and Mann Whitney-U test.

The research found that elderly patients with dementia had False Positive and Miss scores that were significantly higher than normal elderly people, whereas scores for almost all other aspects were significantly lower than the normal elderly, except for Proactive Interference, Retroactive Interference, Error, and Error Association where no significant differences were found. This shows that the test is able to distinguish elderly people with dementia and normal elderly people. The research findings have helped to prove the test as able to screen problems with auditory verbal leaning among elderly patients with dementia. This test is also convenient to administer and does not disturb the patient.

KEY WORDS : RAVLT / VERBAL MEMORY / DEMENTIA

75 pages

การศึกษาแบบทดสอบ เรย์ ออดิโทรี เวอเบิล เลอร์นิง เทส ในผู้ป่วยสูงอายุสมองเสื่อม
THE STUDY OF THE REY AUDITORY VERBAL LEARNING TEST IN ELDERLY DEMENTIA
PATIENTS

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บทคัดย่อ

วัตถุประสงค์ของการวิจัยนี้เพื่อเปรียบเทียบความสามารถด้านความจำจากการได้ยิน (verbal memory) ของผู้ป่วยสูงอายุสมองเสื่อมกับผู้สูงอายุปกติโดยใช้แบบทดสอบ Rey Auditory Verbal Learning Test (RAVLT)

กลุ่มตัวอย่างประกอบด้วยผู้ป่วยสูงอายุสมองเสื่อมที่มารับการรักษาเป็นผู้ป่วยนอก ของคลินิกความจำโรงพยาบาลประสาทเชียงใหม่ จำนวน 37 คน และกลุ่มควบคุมที่เป็นอาสาสมัครจากชมรมผู้สูงอายุโรงพยาบาลประสาทเชียงใหม่ ซึ่งผ่านการคัดกรองโดยแบบทดสอบ TMSE และ TMHQ จำนวน 37 คน เก็บข้อมูลโดยใช้แบบทดสอบ RAVLT เพื่อประเมิน Verbal memory และเปรียบเทียบคะแนนโดยใช้ t-test และ Mann Whitney-U test

ผลการวิจัย พบว่ากลุ่มผู้ป่วยสูงอายุสมองเสื่อมมีคะแนนการจำที่ผิด (False positive) และการจำพลาด (Miss) มากกว่ากลุ่มผู้สูงอายุปกติอย่างมีนัยสำคัญ ส่วนคะแนนในเกือบทุกด้านของกลุ่มผู้สูงอายุสมองเสื่อมต่ำกว่ากลุ่มผู้สูงอายุปกติอย่างมีนัยสำคัญ ยกเว้นคะแนน ด้าน Proactive interference, Retroactive interference, Error และ Error association ที่ไม่พบความแตกต่างของคะแนนอย่างมีนัยสำคัญ แสดงให้เห็นว่าแบบทดสอบสามารถจำแนกผู้ป่วยสูงอายุสมองเสื่อมและผู้สูงอายุปกติได้ ผลการวิจัยดังกล่าวทำให้มีการพัฒนาแบบทดสอบเพื่อใช้คัดกรองปัญหาความจำจากการได้ยินของผู้ป่วยสมองเสื่อมที่มีความสะดวกไม่รบกวนผู้ป่วยมากนักและเป็นมาตรฐานขึ้นมา

75 หน้า

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CHAPTER I

INTRODUCTION

Background and Significance of the Problem

Humans have always tried to control nature in every way, such that our history recounts numerous developments of tools and technology that help make human life more convenient. This includes medical technology which aims at preventing and treating diseases, thus extending human life. In the past humans averaged about 60 years, but as world continued to change, the longer humans are living.

Thailand between 1995-2000 had an average life expectancy of 67.39 years for men and 71.74 years for women, and it is expected that between 2005-2010 the average life expectancy will increase to 68.36 years for men and 73.00 for women (1). The United Nations predicted that in 20 years, the global population will have reached 7.8 billion people, but the elderly (65 years or more) will increase by 10%, which means that the population is aging, with people over the age of 65 increases by 7% and over 60 by 10%. For Thailand, the elderly (60 years and above) increased by 2.445 million (5.46%) in 1990 to 4.016 million (7.36%) in 2000 and 6.617 million (10.17%) in 2005. The data from the Demographic College, Chulalongkorn University, in 2010, Thailand officially had an aging population, with about 7.639 million elderly people or about 11.36% (2). Becoming an aging population brings with it numerous problems, and most inevitably, health and quality of life issues. Elderly people most commonly experience a deterioration of various bodily systems and the onset of various conditions such as diabetes, blood pressure, deterioration of sensory organs, and loss of bone mass. In the end, they have a long life with a rather low quality of life. Dementia is also very common among the elderly, especially, those who are 65 and above.

Dementia is found at exponential rates among the elderly, affecting 1-2% of people who are 60 years of age, 8% of people who are 70, and 50% or 1 in 2 of

people above the age of 85 (3). In the United States, dementia is the fourth largest killer of people. Thai epidemiological studies, often in communities using standard questionnaires from the Statistics Department in 1994, found dementia among 3.4% of respondents, and in 2000 the institute of elderly studies found frequency at 11.4% (3).

Dementia has great economic consequences composed of direct and indirect expenses. Direct expenses for instance include costs of treatment, nursing or caregiver, and indirect expenses include the time of spouse or caregiver, lose of income due to time lose to treatment or care. In the United States there have been numerous study on the study of the care and treatment demented patients, and found that people with mild dementia has an expense of US\$18,408/year/person, those with moderate dementia had an expense of US\$30,096/year/person and those with severe dementia had an expense of US\$36,132/year/person, therefore in there evaluation it was found that the expenses relating to dementia is about US\$50,000 billion a year (5). There have been evaluations as to the effects of the possibility of postponing the onset of the disease by one year, which will reduce the number of patients and the economic consequences of the disease. For this reason, diagnosing patients with the tendency to develop dementia is vital importance.

There are numerous ways to diagnose dementia such as detailed medical history, physical checks, laboratory examination, neuropsychological tests, there have been numerous technological developments in terms of the special tests, such as Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), PET scans etc. Nevertheless, these tools are expensive and increases prices, and only exists in state and private hospitals in Bangkok or large provincial cities, making the possibility of using these tools to diagnose patients very small and difficult. Finding malfunctions with the brain with neuropsychological tests is common clinical procedure, which not only has extensive research but is also a simple too to used, helping to economize costs, and has to adverse side effects to the patient. Additionally, it is beneficial in that it allows for treatment progress to be monitored, and plan patient recoveries.

The Rey Auditory Verbal Learning Test (RAVLT) is a neuropsychological test that measure verbal memory that is immediate, and the ability to learn new things,

where it was found that demented patients have damage to the episodic memory as a result of the medial temporal lobe structure especially the hippocampal formation (6).

For this reason, the research using the RAVLT should be appropriately studied in Thailand, where no serious study has been used before, because it is important to study the quality of the test, so that it may be adapted and used with other clinical diagnoses appropriately.

Research Questions

1. Do elderly people with dementia have different RAVLT scores from normal people?
2. Do different ages affect RAVLT scores?
3. Does level of education affect RAVLT scores?

Research Objectives

1. To study RAVLT score structure of normal elderly compared to demented elderly.
2. To study the limitations and approaches in using the RAVLT

Research Hypothesis

Patients suffering from mild dementia have loses to their ability to learn new things in their episodic memory which the result of the medial temporal lobe structure especially the formation. The Rey Auditory Verbal Learning Test (RAVLT) is a test of neurological test that measures verbal memory that are episodic, immediate and ability for new learning. Moreover, the factors of age and level of education affect memory and learning, resulting in the following assumptions.

1. RAVLT results of patients with dementia and normal patients are different.
2. RAVLT results of the 60-69 group and 70 and above group among normal elderly people will be different.
3. RAVLT results for normal elderly people of different level of education are different.

4. RAVLT scores for the 60-69 group and 70 and above group among demented patients are different.

5. RAVLT scores for demented patients of different level of education are different.

Scope of the study

The population and sample group used in this research is composed of two groups

1. Elderly dementia patients at the Memory Clinic, Chiang Mai Neurological Hospital totaling 37 individuals, with the following inclusion criteria

1.1 Male or female patient who have been clinically diagnosed with Dementia

1.2 Aged between 60-85 years

1.3 At least pratom 4 education

1.4 Has mild or moderate dementia with scores in the TMSE between 10-23.

1.5 No physical abnormalities that hinder the experiment and voluntarily participates.

2. 37 normal elderly people from the Chiang Mai Hospital elderly club, with the following inclusion criteria

2.1 Shares a similar demographic profile as the patients suffering from dementia, no dementia in terms of age, sex and education.

2.2 Aged between 60-85 years

2.3 At least pratom 4 education

2.4 No characteristics of cognitive deficiencies with scores in the TMSE of 24 and above

2.5 Displays no characteristics of depression according to the TMHQ in the depression domain with a T-score of less than 65.

Research Tools

1. The TMSE consisting of 30 questions, measuring six aspects of cognitive function

- Orientation (6 points)
- Registration (3 points)
- Attention (5 points)
- Calculation (3 points)
- Language (10 points)
- Recall (3 points)

2. The Thai Mental Health Questionnaire (TMHQ) developed by Sucheera Phattharayuttawat and colleagues which is characterized by scales, evaluated by ranking in a five scale, totaling 70 questions, designed to evaluate the mental health of the general population, taking about 10-15 minutes. Scores are given at 1, 2, 3, 4 points. The questionnaire measures 5 mental health variables.

3. The Rey Auditory Verbal Learning Test (RAVLT). The RAVLT consist of 15 words which are concrete nouns where each word is related to one another categorized into lists A and list B (interference)

List A: drum, curtain, bell.....

List B: table, ranger, bird

List A will be tested 5 times, called trial I-V (immediate memory). In each trial, all the words in list A will be read for the subject to hear and afterwards, the subject is asked to recite the word they remember, and is repeated 5 times. Then List B is read out (interference) and the subject asked to recite words they remember (proactive interference). Then Trial VI is administered immediately, asking the subject to remember words in list A (retroactive interference). After 30 minutes, the subjects are asked to recall words on list A (trial VII) again. After that recognition is done by reading 30 words and asking the subject to identify whether the word belong to list A, true or false.

Research Variables

1. Independent variables

1.1 Dementia and normal

1.2 Age groups are 60-69 years and 70 and above

1.3 Level of education is separated in to 2 groups namely, pratom, matayom and above

2. Dependent variables: scores of the RAVLT are separated into

2.1 Trial I

2.2 Trial II

2.3 Trial III

2.4 Trial IV

2.5 Trial V

2.6 Trial B

2.7 Trial VI

2.8 Trial VII

2.9 Trial I – V total

2.10 Proactive interference score

2.11 Retroactive interference score

2.12 Primacy effect

2.13 Middle effect

2.14 Recency effect

2.15 Repetition

2.16 Error

2.17 Error association

2.18 Recognition memory trial scores are separated into

2.181 Hit

2.182 Cr

2.183 False Positive

32184 Miss

Basic assumption

Neurologist diagnosis is considered standard.

Expected benefits of the research

1. Able to develop a criteria to categorize patients suffering from dementia using test scores that are appropriate for Thais.

2. Able to recognize problems and limitations of the approach in using the RAVLT in order to use it as an effective tool in the study and research of patients suffering from brain illness in other groups in the future.

Terminology

1. Elderly dementia patients refer to outpatients who are receiving treatment at the memory clinic, Chiang Mai Neurological Hospital who are at least 60 years of age, and receiving a score in the TMSE between 10-23, with a T-score from the TMHQ depression domain of less than 65, and diagnosed with dementia by a neurologist.

2. Normal elderly people refer to members of the Chiang Mai Neurological Hospital Elderly club who do not suffer from dementia and are at least 60 years of age, without signs of cognitive deficiencies, with a TMSE score of at least 24 and receiving a T-score from the TMHQ depression domain of less than 65.

3. The results refer to the scores from the transcription of the RAVLT according to the manual

3.1 Trial I : the number of correct words in list A, Trial 1

3.2 Trial II: the number of correct words in list A, Trial 2

3.3 Trial II: the number of correct words in list A, Trial 3

3.4 Trial IV: the number of correct words in list A, Trial 4

3.5 Trial V: the number of correct words in list A, Trial 5

3.6 Trial B: the number of correct words in list B,

3.7 Trial VI: the number of correct words in list A after Trial B

3.8 Trial VII: the number of correct words in list A after

30 minutes

3.9 Trial I-V total: cumulative results of learning trials I to trial V

3.10 Proactive interference scores: subtracting the trial VI score from the score for trial V (V- VI)

3.11 Retroactive interference score: subtracting the trial B score from the score for trial I (I- B)

3.12 Primacy effect: cumulative results of the total number of words from trial I-V separated into 1-5th in list A

3.13 Middle effect: cumulative results of from trial I-V from the 6-10th word in list A

3.14 Recency effect: cumulative results of the total number of words from trials I-V from the 11-15th word in list A

3.15 Repetition: cumulative results of the words that are repeated but correct from trials I-V

3.16 Error: cumulative results of words that did not exist in list A from trials I-V

3.17 Error association: cumulative results of wrong words but share similar sounds or meaning from words in list A from trial I-V

3.18 Recognition memory trial scores separated into

3.18.1 Hit: True answers that are correct

3.18.2 Cr: False answers that are correct

3.18.3 Fp: True answers that are incorrect

3.18.4 Miss: False answers that are incorrect

CHAPTER II

LITERATURE REVIEW

This chapter presents related literatures concerning the research and use of the Rey Auditory Verbal Learning Test (RAVLT). The researcher has compiled the following literature and research as follows.

1. Memory and Learning
2. Dementia
3. The role of the neuropsychologist in dementia
4. The Rey Auditory Verbal Learning Test

1. Memory and Learning

A model of memory organization in the brain

In the past, the study of human memory is a part of the study of intelligence, whereby in the mid-1800s, it was believed that human intelligence was involved in the functions of the frontal lobe (6,7). Thus it can be concluded that the memory process is related to the frontal lobe as well, until the 20th Century with the advancement and familiarity especially with Wernicke-Korsakoff syndrome, which is caused by chronic alcoholism. From pathological studies it was found that the syndrome affected the nervous system of patients, and found that it caused dorsomedial thalamic nuclei and mammillary bodies. This can be considered a pioneering study of the relationship between the functions of the brain with memory and dementia. Nevertheless, the study did not clearly report its findings, whereby the functions of the mesial temporal lobe structure (especially the hippocampus) was not widely accepted as having to do with memory until the mid-20th century. The role of the basal forebrain with memory became more widely accepted, where memory deficiencies were related to the diencephalic structure until the 1950s and 1960s when studies were conducted on severe HM dementia patients following brain surgery on the mesial temporal structures to treat epilepsy, therefore once again giving

importance to the frontal lobe in terms of its role in the encoding and retrieval process (6).

Memory is not a singular process, but is a complex and complicated construct with many dimension and subsystems that are separated from each other or is made up of a numerous systems combined(4,6,7,8,9). For example, the ability to recall childhood experiences by remembering names of childhood friends uses various memory processes that are different from the storing of new memories such as recalling what one had for breakfast. Additionally, learning new information such as remember telephone numbers is different from the memory subsystem required to learn new motor skill such as riding a bicycle or reading. Some subsystems can be easily damaged from brain injury such as in an accident or stroke. Cognitively and physiologically, memory consists of a variety of different systems. The brain has mainly specific parts that are responsible for learning, storage, and the recall of knowledge, experience, events, or various skills.

The important fact is that there is no memory without learning, for it is the process of acquiring new information, whereas memory is created by permanent learning which can be recalled and used (6,7,10).

It can be concluded that learning is the acquisition and retention of various information which is received from the senses, which is then sent to the cerebral cortex for interpretation and learning, analyzed and stored collectively as memory. Learning is a basic quality of humans and animals, learning causes a change in behavior, and the nervous system is able to store this information in the form of memory (4, 11).

The Learning process consists of (11)

-The acquisition of information, causing experience, that leads to physiological changes to the brain.

- Repeated action using perseverance in order for learning to be effective.

- Without repetition, that learning can be lost.

Memory is the retention of learned information which is able to be retrieved, requiring the central nervous system, describing the complex nature of memory (12,13). Most commonly there are two approaches, 1. The system approach and 2. The process approach (6,7).

System Approach

The system approach views the role of memory as the link between various systems, whereby in some subsystems, which are independent from others in terms of function, therefore if one part of the brain is damaged, it will not affect other systems. Learning and memory can be separated into two different types, namely procedural memory system (nondeclarative) which indicates how, and declarative memory system, indicating what (6, 7, 10) as shown in Figure 2.1.

Procedural memory is derived from motor, cognitive skills and routines, a skill or activity which is accumulated with learning and is able to be maintained without conscious effort such as riding a bicycle, driving a car, and reading. Procedural memory is the function of the brain that connects from the hippocampal but is part of the basal ganglia and cerebellum such as the study in patients of Huntington's disease which has brain damage in the aforementioned region, preventing from learning new skills that are procedural memory (14.)

Declarative memory consists of conscious recollection in the storage of facts, knowledge, experience, and various events. Declarative memory is more easily lost than procedural memory and is the function of the complex part of the brain between the mesial temporal (especially the hippocampus), diencephalic (primary anterior structure) basal forebrain, and frontal lobe structure (6, 7, 8, 14).

There are two types of declarative memory, semantic memory, which consists of general knowledge such as the meaning of words, and episodic memory, which consists of memory created by learning and the collection of facts which are individual and unique to each person, related to time frames. This type of memory is easily damaged if the brain is damaged such as remembering names of friend and teachers in second grade, remembering what one had for breakfast. Neuropsychological studies in amnesic patients found that semantic skills are not damaged, but what is damaged is the ability to recall specific knowledge and information that one has learned such as demented patients being able to recall words 10 words in 5 minutes, but are unable to explain what those words indicate (6, 7, 8, 9)

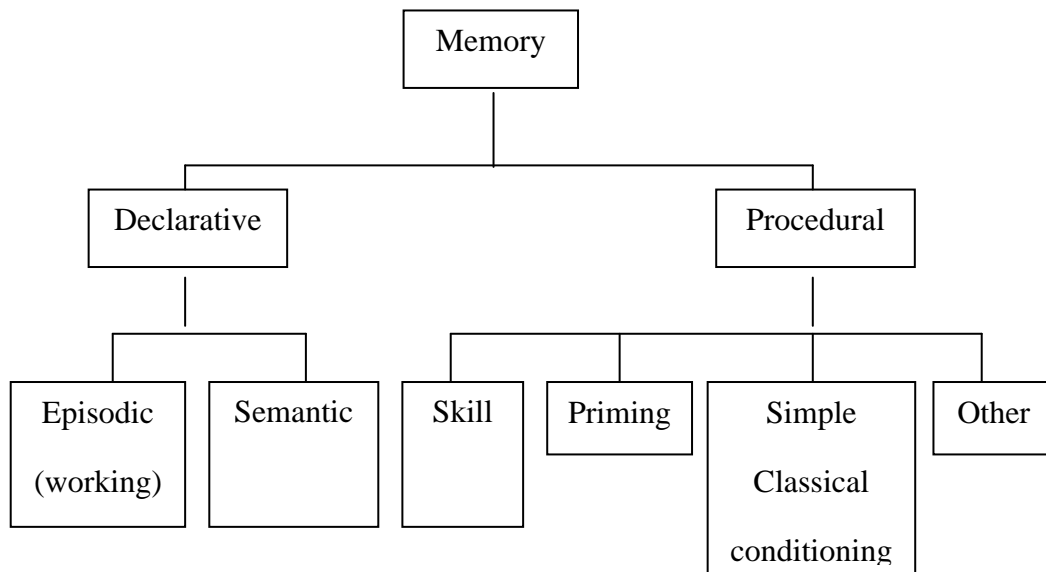


Figure 2.1 The structure of the memory system.

Process Approach

The process approach explains memory in terms of the information processing framework, which uses the steps of the process approach, namely encoding, storage and retrieval (13). Contemporary memory process was born from the approach of Atkinson and Shiffrin in 1968 and was later improved by William James to become primary and second memory, which explains that the information-processing approach in learning and memory creation, explain how information is initially stored, how it is changed from short-term memory to long-term memory, and lastly the ability to retrieve the information from long term storage (6).

The time when information to move from temporary to long-term memory requires the information to pass by several stages, that is information from the environment enters the sensory register and is stored as short term memory, the unit of temporary storage is called working memory which temporarily retains information such as telephone numbers or simple arithmetic. Working memory is an important key in storing information, and leads to episodic memory. The part of the brain

responsible for the encoding of working memory is the prefrontal cortex and parietal lobe (11, 13, 14).

The first stage of encoding is the process of acquiring the information in the part of working memory and when the information is repeated it will develop memory traces. Nevertheless, encoding cannot retain all the information, whereby the strength of the information comes into play. In encoding memory traces can be deep or shallow, some information is lost some is stored. After information is encoded it is able to be changed into short-term memory and at last as long-term memory. This process is called consolidation or elaboration. The part of the brain responsible is the hippocampus and surrounding regions, diencephalic structure, basal forebrain and the cingulate gyrus (6, 7, 14, 15, 16, 17).

During memory acquisition, starting with the registration of information via the sensory nerves, encoding and consolidation of new information, that the process that begins with initial encoding and consolidation that is changed to long-term memory. In the end when the information is needed, the information undergoes retrieval, as explained in figure 2.2. The part of the brain responsible for retrieval remains uncertain despite modern imaging studies. In 1994, Tulving reported that the left hemisphere prefrontal is involved in the encoding of episodic memory and the right hemisphere prefrontal is involved with the retrieval of episodic memory, called the Hemispheric Encoding Retrieval Asymmetry (HERA) Model. Additionally, the temporal-polar region of the brain should be involved about retrieval of autobiographical memories (6, 7, 14, 16).

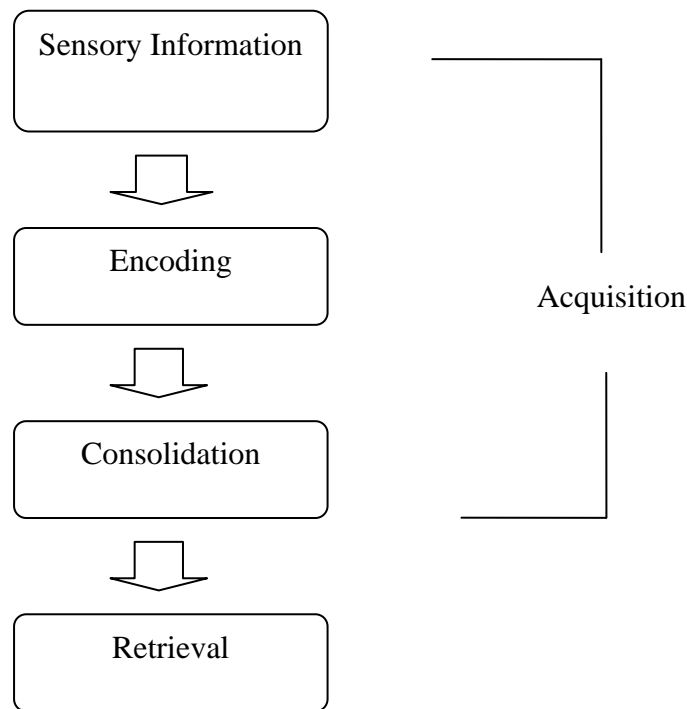


Figure 2.2 The memory process

Therefore the difference between encoding and retrieval is that encoding is a process of information transfer to storage whereas retrieval is the process of accessing information into consciousness. In patients with brain damage who have problems with memory, albeit in terms of encoding and retrieval, this can be evaluated by testing new learning such as through a story of word list and comparing the scores of recall and recognition such as problems with retrieval but encoding remains normal, will find that scores of recognition is normal but fail in terms of free recall. However if there is damage in the encoding process, scores for free recall and recognition will be low(17).

Additionally, forgetting, both in the short-term and long-term memory, is due in part to interference of stored information, of which there are two kinds, namely proactive interference, meaning that past learning interferes with the ability to learn and remember new information, and retroactive interference refers to recent learning

interfering with the recall of previous learning (13). The interference between information learned in the past and information learned in the recent affect memory if the two information are similar to each other, with a lot of information, and the time between them.

2. Dementia

Definition

Dementia first appeared among the native language of the Blancard people and it was found that the word demented was first used the Oxford English Dictionary in 1644 which was translated from the Spanish-French dictionary. Dementia is rooted from the Latin word meaning without mind and in 1760 was widely used by in the medical field (18).

The International Classification of Disease (ICD-10) the World Health Organization explained that dementia is a syndrome due to disease of the brain and is chronic in nature growing in severity to the system of higher cortical function, namely memory, thinking, orientation, comprehension, calculation, the ability to learn, language, and judgement. Conscious is not clouded. Deficiencies in cognitive function will occur, and lose the ability to control tempers, social behavior and motivation, this can be caused by a number of reasons (19).

Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revision (DSM-IV-TR) (12) explained that dementia is that progressive state cognitive malfunction, which includes, memory deficiencies with at least one cognitive disturbance namely, aphasia, apraxia, agnosia, or deficiencies in executive function. The abilities in cognitive function are reduced or fall below average affected work, careers and social (20).

Therefore, dementia is the state the brain's cognitive functions, in many areas are progressively deficient from normal levels, with speech and language, visuospatial function, abstract reasoning and executive function deficiencies as well as behavioral and emotional expression that are affected with normal consciousness, therefore affecting work, careers, and society detrimentally. Dementia is caused from a variety of causes as suggested by numerous North American and European studies

that indicate the Alzheimer's Disease is a major cause, which is found in 50-80% of dementia patients, followed by cerebrovascular disease (vascular dementia), Parkinson's Disease (Lewy Body Dementia) accordingly (21, 22, 23).

The standard criteria for diagnosing dementia is the Diagnostic and Statistical Manual of Mental Disorders Forth Edition Text Revision (DSM-IV-TR) and the International Classification of Diseases (ICD-10) whereby the WHO and the criteria used to diagnose Alzheimer's Disease is the National Institute of Neurological Communicative Disease-Alzheimer's Disease and Related Associations (NINCDS-ADRDA) (24, 25).

The frequency of dementia increases with age, and the rate doubles every 5 years. In England, it was found that the for 65-69 year olds, there is a 1.3% chance, and this number jumps to 32.5% for elders older than 95 (26). In American studies, it was found that about 4 milion patients with severe dementia and about 1-5 million patients suffer from mild and moderate dementia. The frequency of the disease is 5% and 7% for 65 year olds, and 15-20% for 75 years olds and 25-50% for 85 years or older (27).

Types of Dementia

Dementia can be separated into several types, such as through its pathology, clinical characteristics, and progression of the disease.

1. Pathological classification (27, 29)

1.1 Primary dementia is caused by the deterioration of nerve cells. Diseases in this group do not often have a cause, thus becoming a non-treatable dementia namely, Alzheimer 's disease, Pick's Disease, Huntington's Disease etc.

1.2 Secondary dementia is a group of dementia with clear causes due to deficiencies in other areas for the body that affect the brain such as a stroke, infection, poisoning, and metabolic diseases. This group is often in the form of treatable dementia, which includes multi-infarct dementia, alcoholic dementia, hydrocephalic, Creutzfeldt-Jacob disease and AIDS etc.

2. Clinical classification according to the affected region of the brain

2.1 Cortical Dementia is the group dementia that is most prominent in the initial stages with abnormalities such as Aphasia, Anomia, Agnosia, Apraxia, Comprehension dementia, 3-dimensional drawing, assembling pictures. In

the initial stages personality seems normal, but is not aware of the environment, sometimes failing to control their temper. Examples of this group is Alzheimer's disease and Pick's disease.

2.2 Subcortical dementia not only includes symptoms of dementia but also shows signs of other neurological abnormalities such as extrapyramidal system thalamus abnormalities. Patients in this group have psychological abnormalities, loss of cortical function, which is often not severe. Most symptoms are often sluggish, loss of intelligence, loss of determination, forgetfulness, mood swings, often prone to depression. Important symptoms include motor abnormalities, such as sluggish movements, speech, unclear speech, which often occurs quickly in the initial stages of the disease, such as Parkinson's disease, Huntington's disease, Extrpyramidal syndrome etc.

2.3 Dementia with cortical and subcortical dysfunction (Mixed category) is a group of symptoms which occurs between the cortical and subcortical which includes Multi – infarct dementia , Infecteous dementia , Posttraumatic dementia etc.

3. Classified according to the ICD-10(19)

3.1 Alzhiemer's disease

3.2 Vascular dementia

- Multi – infarct dementia
- Subcortical dementia

3.3 Dementia from these disease

- pick's disease
- Creutzfeldt-Jacob disease
- Huntington's disease
- Parkinson' sdisease
- Human immonodeficiency Virus (HIV) disease

Disease Progression

Dementia can be found in middle age to the elderly, but may also be found in younger people, but rarely in people below 45 years. The progression of dementia can be explained in three stages (3, 15, 28, 29, 30, 31).

1. Mild dementia (duration 1-3- years) where in the initial stages symptoms are rather unclear, with slow progression, making it difficult at times to specify when the disease has started. Important symptoms include memory abnormalities most clearly seen in short-term memory especially with the patients asking questions repeatedly and are better at remembering things in the past. They begin to develop problems with language use, having difficulty with diction, unable to assign names to certain objects, but rather explain the option such as calling a television a movie box. During this stage the individual loses interest in their environment, hobbies and the pursuit of new interests, limit emotional expression, and rather dull. They have difficulty with complex decisions such as financial management, albeit in the initial stages they are still able carry out their daily lives, and are aware of their own abnormalities which may cause depression.

2. Moderate dementia (duration 2-10 years) in this stage the patient's symptoms are more clear, and are unable to remember doing certain things such as eating, using the bathroom, lose of memories in the past, at times they are even confused about time, place, getting lost in familiar places, confusing people in the family for someone else, having difficulty recalling names of family members, display of inappropriate behavior such as repeated behavior, having difficulty with speech, neglecting their personal hygiene and eating.

3. Severe dementia (duration 8-12 years) is the final stage of the disease, the patient is unable to take care of themselves, needing a helper to assist them in eating, cleaning and clothing themselves, using the bathroom, having problems controlling use of the bathroom, unable to remember those close to them, unable understand and sometimes letting out irritating meaningless sounds or sometimes simply not speaking. They may display agitated behavior during the night, aggression, inability to walk or move, simply lying on the bed tensed, needing to be taken care of in all aspects of their lives. The patient will usually die due to pneumonia or infection due immobility.

3. The role of the neuropsychologist in Dementia

Neuropsychology plays a major role in the diagnosis, able to distinguish between age-related decline, mild cognitive impairment, and dementia such as Alzheimer's by evaluating the various aspects of cognitive function as well as the person's day-to-day cognitive function. Having a dysfunctional memory does not clearly indicate only dementia, but may also be caused by other problems such as such as problems with free recall which may be caused by a number of reasons, such as confusional state, depression, or attention disorder which may be found during the encoding stage(32). Problems at the retrieval stage may be found in depression, frontal lobe dementia, subcortical dementia or frontal lobe-related deficit, or simply the patient has a low free recall score which may indicate pure amnesic disorder which is the result of hippocampal or temporal lobe damage. It can be concluded that the role of the neuropsychologist is the measurement and diagnosis of the pattern and level of cognitive impairment.

In early and middle stage of a dementing process, the assessment of cognitive status will help guarantee the individual's day-to-day safety and help in the diagnosis of the final stage of dementia. The evaluation is related to problematic behavior such as wandering, screaming, or verbal abuse in planning the treatment and administering psychotropic medication in order to control the aforementioned behavior(32).

In the evaluation of cognitive function there are screening measure tools such as the mini mental state examination (MMSE), the seven minutes screen, clock drawing test (CDT), the Alzheimer's Disease Assessment Scale (ADAS) (32, 33) and a tool called the Laboratory Cognitive Neuropsychological Assessment which is specifically designed for patients with mild symptoms and possible dementia in the part of executive function or have depression. Neuropsychological testing is able to assess the severity, cognitive ability in each domain, and indicate the pattern or profile of cognitive impairment. Neuropsychological testing consist of various aspects of cognitive profile including, language function such as the naming test, category fluency test, letter fluency test, visuospatial function such as block design subtest in

the WAIS, drawing task; circle, Red Cross sign, diamond, cube. Executive function consists of problem solving tests such as the Wisconsin Card Sorting which assesses mental flexibility such as the Stroop, Trail Making Test etc. The memory function consists of verbal memory tests such as the Rey Auditory Verbal Learning Test, California Verbal Learning Test, Hopkins Verbal Learning Test, Selective Reminding Procedure. Nonverbal memory include the Rey Osterrirrh, Benton Visual Retention and Test Batteries such as Wechsler Memory Scale-III, Memory Assessment Scale (6).

Examining Memory

Memory is the ability to retain information and use the information. An effective memory is the functioning of many parts of the brain, and some parts which are especially susceptible to injury or disease. Additionally, neurological and psychological factors are able to affect memory. Riedel-Heller and colleagues found that individuals who are 75 or older who do not have dementia often have complains about memory. Furthermore, it was found that outpatients will have anxiety concerning memory and is the leading cause of further neurological diagnosis, therefore examining memory is considered the center for neurological testing (8, 33).

Examining memory effectively in adults should assess attention first (8, 33), because attention is the fundamental basis for memory because in a problem develop, because if a problem develops in the part of the span of immediate verbal retention (e.g. digit span forward) or simple mental tracking (counting backwards by 3s or 7s) may obscure test results demanding that the test be administered again once the individual is ready.

Comprehensive memory evaluation is composed of (8)

1. Orientation to time and place
2. Prose recall to measure learning and retention of information that is clear that is memorized by listening to conversations such as the Wechsler's Logical Memory Stories.
3. Rote Learning ability which as a learning curve and measure free recall and recognition such as RAVLT and CVLT.
4. Visuospatial memory such as complex figure
5. Remote memory
6. Personal-autobiographical-memory.

In tests that measure memory, if there is a physiological problem that hinders the test such as speech or hearing, visual memory is able to be used in its place. Nevertheless, deterioration or injury to the brain in one way or another affecting test that uses verbal memory and visual memory such as the left hemisphere lesion which affects verbal memory, the right hemisphere lesion affect visuospatial recall, therefore in testing those with problems, it should test both verbal and visuospatial memory.

Verbal Memory

There are many tests for verbal memory used in the present, but few have reliable norms, therefore the examiner of these tests must consider appropriately which type is best suited to the patient or to the research. In general, there verbal memory tests using a variety of techniques such as verbal automatism which measures learning of words from reading in early childhood, often of words commonly used in everyday life, and able to recall them unthinkingly, effortlessly, and automatically such as letters of the alphabet, numbers 1-20 or 100, days of the week, months of the year, a patriotic slogan or a long-practiced-prayer. Automatism is the least likely to deteriorate, but can be found in acute conditions at consciousness, or nonacute which is severe such as advanced dementia. Testing short-term retention, it is popular to adopt the distractor technique called the Peterson task, the Peterson and Peterson procedure or the Auditory Consonant Trigrams (ACT)(8).

Most elderly people and patients with brain disorders are capable of immediate memory span that is no different from youths or adults, therefore test that simple span such as digit span-forward or backward are unable to measure dysfunction in immediate recall, and therefore must increase longer and more complex forms called supraspan such as test that word lists.

The use of words in memory test, albeit single words or groups of clauses or excerpts affect results of tests, which is dependent on age, pathological characteristics, and intelligence of the patient. In English, the development of tools that use words to test memory and learning, developers used the Togia and Battig's Handbook of Semantic Word Norms, which includes 7 dimensions, namely, concreteness, imagery, categorizability, meaningfulness, familiarity, number of

attributes or features and pleasantness, therefore in order to increase consideration in terms of bias in the word list, Locasio and Ley compiled the words that are meaningful totaling 319 words, Pavio compiled 925 nouns according to concreteness, imagery, meaningfulness, as well as Palermo and Jenkins's Word Association Norms also compiled information pertaining to the frequency of word use and the relation of each word for the 86,741 words in English(8).

In some memory test situations, there is a need for speed, such as hospital bedside tests which must use words that are short and familiar, most of which are mental status examinations totaling about 3-4 words. Each word is not related to each other, are simple words such as the names of days, flowers, or groups of words such as ordering flowers (two dozen yellow roses). In the evaluation of mental condition, the words will be said and the patient will repeat those words immediately in order to test memory register, after which it might be followed by interviews under various topics such as work history, family history, which lasts for about 5 minutes. Then the patient will be asked to recall the words they have repeated earlier again. For hospital bedside testing, Frank Benson created the Benson Bedside Memory Test by using 8 words which are read aloud and asked to recall in a total of 4 trials and a free recall after about 5-10 minutes followed by category-cued recall for words that cannot be recalled.

In word list learning testing, there is a predetermined list of words used to test supraspan which are simple words that are familiar, each word is unrelated to each other such as in selective reminding which uses 12 words, the RAVLT which uses 15 words. S.C. Brown and Craik found that in normal individuals, supraspan learning testing in terms of short-term retention and the ability to learn will work together. In patients with brain dysfunction will perform as well as normal individuals in the first trial but will have limited learning in following trials. Short term retention with learning disabilities will be able to recall later words in the list (the recency effect), that is the learning of new words interfere with the old, but in normal individuals it is found that primacy and recency are equally good in the moderate level(8).

4. The Rey Auditory Verbal Learning Test (RAVLT)

Test Characteristic

The RAVLT test consist of 15 words which are concrete nouns, each word is not related to each other in terms of definition and pronunciation. The words used are 1-2 syllables and has a frequency from the Thorndike – Lorge frequency of at least 50 in a million. Additionally, they also stimulate high imager. There are two sets, called list A and list B (interference). As for words used in recognition memory will not exceed vocabulary in the third grade (8, 33, 34, 35, 36)

List A: drum, curtain, bell

List B: table, ranger, bird,

List A will be tested a total of 5 times, calling them trial I-IV (immediate memory). In each trial the words in List A, the subject will be asked to listen to the words and then asked to recite the words they are able to remember in a total 5 times. Then they are asked to read the words in list B (interference) and asked to recite the words again (proactive interference). Then Trial VI is commence immediately, and asked to recall List A (retroactive interference). After 30 minutes, the subject is asked to recall list A (trial VII) once again, then they are asked to do recognition by reading 30 words and answer which words were part of list A or not.

Test Procedure

There are a number of advices in terms of the administration of the RAVLT, albeit in terms of choosing the normative group that is used to compare the subjects and the need to measure the specific memory. For this study, the procedure the processs of Ivnik, Malec, Tangalo, Peterson, Kokmen and Kurland(34).

Administration Instruction

RAVLT is an individual verbal learning memory test. The test is administered in a quiet room without any distractions. Prior to administering the test, an adequate rapport must be developed with the subject, prepare the various tools, as well as the procedures in order to prevent any distraction to the subject because the test uses reading and listening. The recommendations are as follows.

Learning and Recall Trials

“In a moment, I will read you a series of words. Listen to them carefully. When I have finished reading, repeat the words you remember, they do not need to be in the order they were read. Please try your best”

Read the words clearly, reciting 1 word per second. Record each word in the order the subject is able to recall them.

“I will now read you the words in the same group to you again, and once again once I have finished reading them, you are to repeat all the words you remember including the ones you have said during the first trial. They do not need to be in any order, just all the words you remember.” It is advised that at this stage, the administrator must emphasize that the subject must repeat words they have already stated before. Use the same procedure for trials II to trial V.

After that commence list B according to the following recommendations

“I will now read you words from set 2, repeat all the words you remember from this set, and like always, they do not need be in any particular order. Please try as many as you can.

Trial VI is conducted after list B is completed, whereby the subject is asked to recall words from list 1 without hearing the words as recommended below.

“I will now ask you to repeat the words from list 1”

Trial VII (delayed recall trial) is commenced 30 minutes after the completion of trial VI, and is commenced without warning using the following recommendations “...I have read you words from first list a number of times, now, please recite all the words you remember from that list”. In this trial, clearly indicate that it is words from list 1.

Recognition Memory

Measuring recognition memory is done by using a set of 30 words and use the following recommendation “...I will read you a set of words, and ask you if the word is from list 1 or not, by using the words true or false”. In this stage, the subject can answer by using appropriate gestures such as nodding or tapping one’s finger when answering true.

Recording Response and Scoring

The response recording and scoring refers to the RAVLT handbook record sheet and score summary form WPS Product No. W – 322B. (8, 34).

Recording responses must be according to the order they are recited (as well as repeated words) and scored as follows.

R: Repeated words

RC: Repeated words that subject realizes is repeated (such as saying I've already said this word)

RQ: Repeated words but subject questions whether they have said the word already or not

E: Wrong words consisting of EC: wrong words that are not in the list EA: wrong words that are due to pronunciation or relative meaning

Recognition

Record the number of correct responses by separating into

Hit: Answering true and the word is in list A

Correction rejection (CR): answering false and is not a word in list A

Record the number of incorrect responses by separating into

False positive: Answering false and is a word from list A

Miss: Answering true and is not a word from list A

Scoring

calculate scores according to the test manual as follows

1. Trial I the number of correct responses in list A in the first time
2. Trial II the number of correct responses in list A in the second time
3. Trial III the number of correct responses in list A in the third time
4. Trial IV the number of correct responses in list A in the fourth time
5. Trial V the number of correct responses in list A in the fifth time
6. Trial B the number of correct responses in list B
7. Trial VI the number of words in list A recalled after Trial B
8. Trial VII the number of words in list A recalled after 30 minutes
9. Trial I – V total results of learning trials I – V

10. Proactive interference score: scores from trial I – List B
11. Retroactive interference score: score from trial V – trial VI
12. Primacy effect: total word score from trial I – V that comes from words 1 – 5 in list A
13. Middle effect: total word score from trial I – V that comes from words 6 – 10 in list A
14. Recency effect: total word score from trial I – V that comes from words 11 – 15 in list A
15. Repetition: total results of number of words from trial I-V that are repeated but correct.
16. Error: total number of words that are not in list A from trials I – V
17. Error Association: total number of words are wrong in terms of pronunciation or related meaning to words in list A from trials I – V
18. Recognition Memory Trial Score is separated into
 - a. Hit: True for is the correct word
 - b. Cr: False for the correct word
 - c. Fp: True for the incorrect word
 - d. Miss: False for the incorrect word

Functioning of Different Memory Mechanism, as Assessed by RAVLT

RAVLT is not tool used to assess rote verbal memory alone, but can also measure memory process and indicate dysfunction in memory mechanisms which leads to memory loss.

From the study of factor-analytic of Ryan and colleagues, Vakil and Blachstien in a sample group of 146 people, it was found that the basic factor measured in the test is acquisition, retention, storage and retrieval, and can be concluded that verbal memory function is able to be separated into explained according to the RAVLT scores as follows (37)

1. Recall on Trial I represent immediate memory span for words. In general, memory span for words is congruent or similar to memory span for digit and similar to scores from trial B (interference list)(8). This is because both measure word list in the first time. The study of Tierney and colleagues found that the norm in healthy adult males aged between 13 – 79 had scores in trial 1 between 6.8 and 5.5

depending on age. In moderately impaired Alzheimer's disease patients, the scores from trial 1 is only 2.7 (SD = 2.1)(37).

2.Scores from trial I that is higher than trial B indicate the effect of proactive interference(37) and indicate the difficulties in changing response set (8), as for the score difference in Trial V and VI indicate abilities in retention of new information and is related to retroactive interference as well. Both proactive and retroactive interference reflect executive and/or memory dysfunction in the study of Torres et al. found that schizophrenic patients are susceptible to retroactive interference (37). Tierney et al. found that the norm for healthy adult males between 13 – 79 have scores in trial VI is between 11.8 – 8.1 and in moderately impaired Alzheimer's Disease patients have scores for Trial VI at 1.8 (SD=3.0) (33).

3.The results of trial I – V or an increase in the score between trials show a learning curve. The angle of the curve indicates verbal learning ability. The difference of scores from Trial V and Trial I indicate acquisition of verbal learning. The study of Tierney et al. in normal group below 70 years of age found that most will remember 6 – 8 words from trial I and up to 12 – 14 words in trial V. If there is little learning or hardly no learning at all, it is most commonly found in demented patients such as moderately impaired Alzheimer's and Parkinson which averages at about 2.7 – 2.9 in Trial I and increase to 5.3 words in Trial V (37). In some studies, it is found that brain damage patients will have scores as good as healthy persons in Trial I but will have difficulty increasing learning in later trials.

4.Serial Positions indicate functioning of specific memory mechanisms. Primacy and recency effects are tools that indicate vulnerability in proactive and retroactive interference. It is able to distinguish problems in the stage of encoding, but if recency effect develops in the normal group, it can be found both primacy and recency effects, which is the ability to recall and the encoding process which is normal. This explains the theory of the u-shaped serial position curve in recall memory. There are numerous studies such as Murdick, Robinson & Brown, Ebbinghaus, Nipher(13, 14) which is after the reading of the word set, primacy and recency will be better than the middle of the list. This can explained according to the memory process of Atkinson and Shiffrin which is that primacy effect is the memory in the beginning of the list passes sensory memory to the short-term memory. When

this remains in short-term memory and is rehearsed, these words will be stored in long-term memory. Primacy effect occurs when information is recalled from long-term memory. Conversely, the words in the middle of the list which is not rehearsed that is rigorous enough and thus not often recorded. As for the recency effect, it can be explained that recalling information from short-term memory because towards the end of the list, it remains in short-term store and thus is able to recall the information easily and ready to use. The study of Tierny et al. found that AD and Parkinson's Dementia will have recency effect more than primacy effect(33).

5. Intrusions are words that are wrong and are apart from the list and indicate the tendency for semantic or phonetic confusion, which may be confabulatory response. Additionally, in the part of repetition, repeated the correct words often may indicated self-monitoring function dysfunction(8, 37).

The History and Origins of the RAVLT

In 1916, Edouard Claparede created a word list learning test consisting of 15 words. Later on, In 1941, Swiss psychologists Andre Rey developed the RAVLT which is considered the first edition of the word list learning test (8, 16, 22). At that time, it was used as a tool used to evaluate the relationship between recall task and recognition task. Later on, the test was translated into English and improved for use with children. Taylor in 1959 changed three of the original French words (Bell – Belt, moon- sun, nose – mustache). In 1964, Rey improved the test by adding the 5 free recall trial and the recognition task(35). In 1976-1983, Lezak improved the procedure with simple instructions and simplified the test to make it easy, simple and straightforward, whereby after introducing the procedure, the sets will be read slowly and clearly, at a rate of 1 word per second for the subject to remember the most words without having to remember the order in which it was recited. This process is called learning trial, which repeats itself in 5 trials (trial I – IV). Lezak suggested the part of recognition afterwards, using, Rey's story recognition memory trial (consisting of a variety of words that are similar to the learning list and with only 1 word from list B) or a 50-word list, on or the other. Additionally, he also suggested the evaluation of delayed recall 30 minutes after trial VI(8).

Additionally, there is an interesting way of recognition amongst children which is a mixed neurological sample, the study of Bishop, Knights, Stoddard by

reading sets of 3 words made of words from list A, B and others, and letting the subject repeat words in List A(34).

In the part of recognition memory in the first edition, Rey will conduct it immediately after completing the 5 learning trials, characterized by 30 words called the 30-words story and asked to tell which words were from the learning list or not. Taylor omitted the part of recognition but replaced it with words in set 2 as an interference trial and added trial V. At present the RAVLT has been improved in a number of ways, but the procedure proposed by Taylor is considered the modern fundamental method (34, 35).

In modern studies of the RAVLT, there are numerous ways to carry out the test, but most follow the Lezak version which consists of 5 learning trials with words from list A, learning trial from list B, recall trial (Trial VI) followed by recognition which is a story, word list or another method, whereby 30 minutes after the recall trial is the delayed recall (trial VII) and lastly is the recognition trial. In the present, there have been developments to the original version into many languages such as English, Hebrew, German, Italian, Dutch, Greek, Portuguese, Chinese etc.

As in all tests, the RAVLT has its limitations. Firstly, there are numerous reports of the norms in studies, making it impossible to use norms to compare all the results because of different methods, therefore choosing an appropriate norm should use a study that has a normative group that is similar and have the same administration instruction. Secondly, the RAVLT has a ceiling effect in some groups, which are youths and bright individuals. In testing the elderly, especially amongst those with possible cognitive impairment, there may be an obstacle in the form of sensory or motor deficit, confusion or lack of understanding in the test procedures(34).

Reliability

There are numerous studies showing the test-retest data separated into each trial. Geffen, Butterworth and Geffen studied equivalence from parallel form which is developed from the original form among volunteers of a normal group. During the measurement of test-retest 6-14 days, whereby the group is separated in half with one group sticking to the original form first and the other group doing the parallel form as the first form. It was found that test-retest interval ranged from .12-.85, with

reliability in Trial IV, V, and VI, delayed recall and recognition that is correlation ranging from .20-.85 (median $r = .60$) (34).

Delaney and colleagues found that this test has a high test-retest reliability using the parallel forms: List A and List C in retesting within 1 month for the normal group. There is a correlation range from .61 to .86 in trial I – V and from .51 to .72 in delayed recall and recognition trials (34).

Uchiyama and colleagues studied the test-retest data in a 322-person sample group from Forms AB with separation time of 6 months and in another 47 person sample group with a retest of 1, 2, and 3 years and found that test-retest correlation of each trial have a significant correlation (34).

Snow, Tierney and Zorito in completed a study in 1988 and found that test-retest of the RAVLT in the one year study has a median of .55 but in terms of total number trial I – V the reliability is as high as 0.7 and in list be a low reliability of 0.38. In the study of Crawford and colleagues it was found that in terms of the alternate form, the same set is able to be used without any significant statistical difference (33).

Validity

Content Validity

The RAVLT has a decent content validity with a face validity by being able to clearly integrate the objectives of the tool as verbal learning test that uses words that easy, simple, and generally known, as well as using a simple methodology. In RAVLT testing, the subjects must learn the words in the list and then followed by the interference list, a step that measure retention, which must be complete sometime after, showing the capacity of memory function and clear verbal learning(34).

Concurrent Validity

There are numerous studies of factor analytic that indicate concurrent and criterion validity of the RAVLT, such as the study of Ryan, Rosenberg and Mittenberg among a sample group of 108 men who are psychiatric and neurological patients using the WAIS-R, Wechsler Memory Scale (WMS) and RAVLT using principle component factor analysis with varimax rotation. The results indicated that the RAVLT is directly correlated to other verbal memory tests (34).

Crossen and Wien conducted a comparison study between the RAVLT and the CVLT and found that they are correlated at .32 at Trial 1, .33 in trial 5, .47 in word recall, and .37 in short delay recall (34).

There are numerous other studies concerning factor analytic which found the correlation between the RAVLT and other verbal memory test, but did not find correlation with motor and visuospatial tests. Additionally, Malec and Thompson reported the relationship between the RAVLT and the subjective symptoms reporting tests as well (34).

In terms of comparing the RAVLT and neurodiagnostic method research and confirm lesions, there are numerous studies as well, and is conducted on numerous groups of patients such as patients with focal cerebral lesions, temporal lobe epilepsy, brain injury, and dementia etc. Miceli studied the Italian version of the RAVLT using scores from trials I-V and delayed recall (15 minutes) in patients with focal cerebral lesions who have received neurodiagnostic diagnosis which consists of 82 right hemisphere injured patients and 67 left hemisphere damaged patients. It was found that left hemisphere patients clearly had lower scores than right hemisphere patients but no score differences were found from scores of losses in each lobe such as temporal versus frontal versus occipital versus parietal lobe(33).

The study of Ivnik and colleagues found that RAVLT scores for patients with left hemisphere damage is lower than score for patients with right hemisphere damage. M. Jackson, Fux reported that the RAVLT is sensitive to different memory disorders such as among heavy drinkers, who score low despite no neurological signs. Janowsky conducted a study among Korsakoff and found that that scores were consistently poor for all 5 trials, but scores improved in the part of recognition which is tested after the 5 trials. In the same administration, frontal lobe patients scored low in all 5 trials, but score similar to the normal group in recognition, which indicates that they are able to learn the word list, but have difficulty in retrieving, organizing, and keeping track of memory in the word list (33)

Ivnik studied RAVLT score of temporal lobe epilepsy patients (TLE) both pre- and post-surgery and found that scores for left-TLE and right-TLE are not different, but post-surgery it is found that left-LTE patients have lower scores(33, 34). In 1994, Ivnik studied a group of 533 normal elderly and 422 elderly people in the

mixed neurological group consisting of 81% dementia, 6% vascular disorder and psychiatric illness, and 3% substance abuse and found that average index for the RAVLT among the patients was lower than normal by 1.7 – 1.9 SD which indicate the ability to distinguish abnormalities.

Mitrushina and colleagues found that in the group of early stage Alzheimer's disease, there is a learning curve that does not change much through the 5 trials, averaging about 6 out of 15 words(33). Additionally, Bigler found that there is intrusion between list A and list B more than any other group. Tierny reported that when there is progression of the disease to the moderate stage, word memory in trial 5 is reduced to 5 on average, but when the disease has progressed to the severe stage it is found that in trial 5 retrieval is reduced to an average of about 2.6 words.

Additionally, in the study of Vakil & Blachstein in 1993 (33) concerning the relationship between the RAVLT and other learning instruments, it was found that there is a correlation ranging from .50 to .65, and that a study of factor analytic in the normal group showing that the RAVLT is a tool that is able to measure memory in the part of acquisition, storage, and retrieval.

Moderate Variables of the RAVLT

1. Age. In most standard studies of RAVLT scores, there will be distinguish by age, and is found that in general age significantly affects scores. For children, scores improve with age, and for adults, scores decrease with age. However, in the study of Munson where no correlation was found with children between 13-16 years old(34). Studies in children sample groups found significant correlations such as the study of Bishop among children aged 5-16 years who are mixed neurological (head injury, epilepsy, LD, attention deficit disorder). The study found a correlation between age and the total scores for trials I-V, delayed recall and recognition memory. Talley reported the correlation of age and RAVLT score between children with learning disabilities and adolescents ranging from .19 to .36(34). Quesy and Megran studied a large number of patients in patients with general illnesses at VA hospital and found that learning ability amongst those older than 70 is reduced by 50% compared to those between 15-24 years(34, 37).

2. Education. The correlation between education and RAVLT scores ranges from low to moderate. Geffen found significant correlation between the level

of education and scores for Trial II to V(34). Uchiyama reported a correlation between level of education and scores for trial V in multicenter AIDS Cohort Study(34). Davidoff found that level of education is correlated with RAVLT scores for acute spinal cord injured patients(34). The report of Mitrushina did not find any correlation between level of education and RAVLT scores in retirees(37).

3. Intelligence. Reports of study of the correlation between intelligence and RAVLT scores are rather few and often did not find many correlations. Geffen and colleagues found that intelligence and RALT scores are significantly correlated in Trials I, VI, and delayed recall. Similarly, Query and Berger compared WAIS FSIQ scores and found a significant correlation with RAVLT scores in the part of recognition memory but not for learning(34).

4. Gender. Reports about gender and RAVLT scores are unclear such the normative study in one of the three studies that gender affects RAVLT scores, whereas the other two studies did not find the same conclusion. However, in studies that are interested in gender, most will find that RAVLT scores in women are higher than men, but in the study of Forrester and Geffen did not find that gender affected RAVLT scores in children between 7-15 years of age(34). Nevertheless, according to Munson who reported that RAVLT scores for groups aged 13-16 years of age, were higher in girls than in boys in the part of learning trial. In the part of the study of 134 normal individuals aged between 16-76 years by Savage and Gouvier and found no effect of gender on RAVLT scores(34, 37).

5. Ethnicity and Culture. There are few studies as to the effects of ethnicity and culture on RAVLT scores. In the United States, Uchiyama and colleagues studied the effects of ethnicity on RAVLT score using a sample group of 2,059 homosexual and bisexual males who are HIV-1seronegative and 12% of this group represents the minority. This group uses only scores for trial V only and found that ethnicity affects scores in trial V significantly(34). Additionally, the WHO conducted a study on the RAVLT in different countries where Maj made certain changes to the order of the words from the original version for certain cultures such as turkey, curtain etc, and developed the A WHO/UCLA version. There have been studies using the original and new studies in Germany, Italy, Thailand and Zaire which found that significant score differences for each country in the original version but not in the new version(34, 37).

6. Clinical Diagnosis. There are numerous studies which indicate mixed group from neurological and normal groups, whereby the RAVLT test in each group such as educationing adults by Powell, among the elderly nu Drebing, Van, Gorp, Stuck, Mitrushina, & Beck; Ivnik, Smith, Malec, Kokmen, & Tangalos. Powel suggested a way to distinguish normal groups from neurological patients using the score criterion in trial V which is less than or equal to 12 and the total score in Trial I-V equaling 50 or less(34). Debring studied and proposed cutoff scores for various diseases. Ivnik found that the average score for neurological patients will be lower than normal by 1.7 – 1.9 SD by comparing from Mayo norms(34).

In the study of neurological patients where the focal lesion is known conducted by Miceli, Caltagirone, Gainotti, Masullo, & Siliveri found that RAVLT scores were lower for those with left hemisphere lesions compared to other patients. Nevertheless, specific lesion sites within the left hemisphere(34).

RAVLT scores will decrease with patients such as Amnesics. Butter, Mungas, Squire & Shimamura found characteristics of a learning curve which displays not change as well as patients with Dementia, Alzheimer's, Huntington, Parkinson and Korkoff as well(34).

Studies by Bigler, Mungas and O'Donnell among head trauma patients found that the learning curve increased with each trial, but the overall score is lower than the normal group, which is the same characteristic found in mild head injury and learning disabilities group as well(34).

In the study of Mungas, among psychiatric patients, low scores were found, which Wolf, Ryan, and Mosnaim additionally proposed that psychiatric patients with tardive dyskinesia will have even lower scores(34).

The study of Sutker in a malnutrition group from prisoners of war who experienced substantial weight loss found that RAVLT scores were low. Nevertheless, Szmokler did not find that characteristic among anorexics(34).

There are numerous studies that are interested in applying the RAVLT to HIV patients which found a variety of results, ranging from scores that were lower among those infected and some studies that did not find any difference when compared to a controlled group. In the study of Ryan and colleagues found that AIDS will have scores than regular group. Whereas Miller did not find any RAVLT score

difference in the regular group and the infected group who are in the early stages of the disease progression(34).

It is found that in many diseases, the severity of the disease is correlated with lower RAVLT scores such as dementia patients who are Alzheimer's type, Wilson's disease, head trauma and learning disability.

1.Emotion Status. There are some studies that evaluate the effects of the emotional status on RAVLT scores. Mostly it is found that patients with depression will have lower scores than normal. Chiuli and colleagues found that depression patients have false positive tendencies which are caused by similar voices in recognition memory(34). Ginotti and Marra found RAVLT scores differences among elderly who are pseudodementia from depression which makes their scores lower than normal. Nevertheless scores are higher than Alzheimer patients(34).

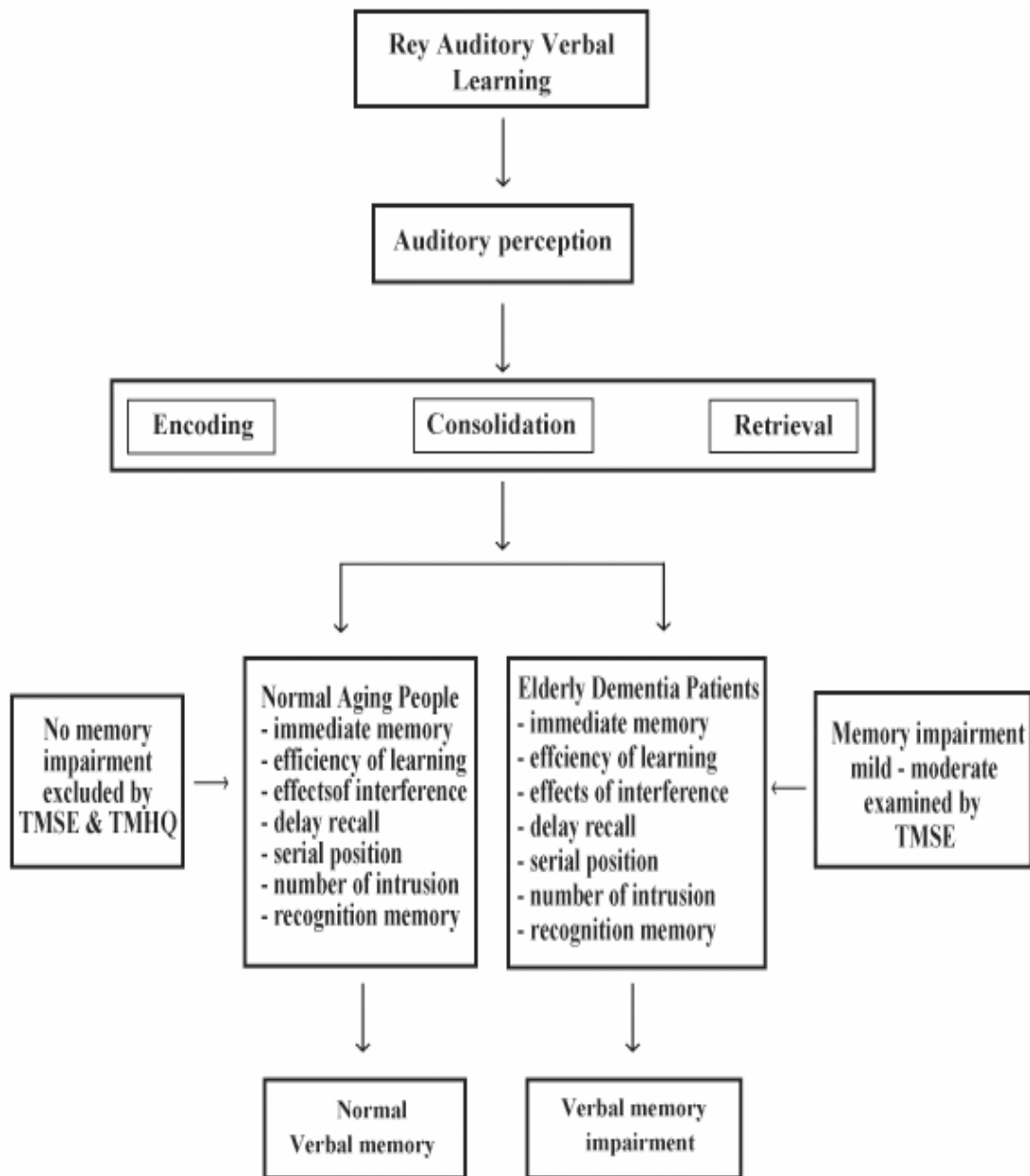
Additionally, there are test of the relationship between RAVLT performance and psychological measures of depression such as Query and Megran, which found that the state of depression which is found with the MMPI affect RAVLT scores only for trial I only. Hinkin studied among HIV patients and found that Beck Depressive Inventory (BDI) is related to RAVLT scores only for scores on trial B and found no significant differences between RAVLT scores between low score groups <9 and high scores >20 in the BDI(37)

In terms of studies of the relationship between anxiety measures and the RAVLT Wiens did not find any correlation between RAVLT scores and the Spielberger State-Trait Anxiety Inventory but Unkenstein and Bowden found a clear relationship between the RAVLT Trial I-V total and the State Anxiety from the Srait Trait Anxiety Inventory ($r=.57$). Additionally, Gibbs et al. also found significant relationships between the Profile of Mood States Anxiety score and RAVLT Trial I-V total ($r =.28, p<.05$) as well(34).

Therefore, it can be found that there are many factors that influence RAVLT scores, both large and small, and therefore the interpretation of the scores must be done so carefully, and take into considerations these factors.

Conceptual Framework

Learning is a fundamental human characteristic and memory is created by learning that is permanent and able to be recalled which is called the memory process. According to the approach of Atkinson and Shiffrin, the memory process consists of three steps, namely encoding, consolidation (successful storage) and retrieval. Learning and memory often affect our lives. Memory problems are caused by a number of reasons, and dementia is the leading cause of memory deficiencies in old age. From the theories and bodies of research it is found that dementia patients will have visual memory problems and verbal memory especially, initial stage patients will have problems with new learning in the part of episodic memory. The Rey Auditory Verbal Learning Test (RAVLT) is a neuropsychological test that measures verbal memory in the part of episodic memory by measuring immediate memory learning. The aforementioned have been compiled and summarized as follows.



CHAPTER III

MATERIALS AND METHODOLOGY

This is a descriptive research to study the mean scores for the Rey Auditory Verbal Learning Test for the normal elderly and elderly with dementia

1. Population and sample
2. Research tools
3. Research procedures
4. Data analysis and statistics

Population and Sample

The population and sample of this study were the normal elderly people who are part of the Chiang Mai Neurological Hospital elderly people's club, and elderly patients suffering from dementia at the Memory Clinic, Chiang Mai Neurological Hospital.

The sample group was derived using clinical formulations (38) and population ratio to calculate the 10% frequency of the dementia patients (39, 40)

Fraction expose = 0.96; Relative risk = 0.10

Confidence Level = 0.95; Power = 0.80; Ratio = 1.00

Sample size = 74.35; case size = 37.17; control size = 37.17

Using this method, a total of 74 peoples are used in the evaluation, in two groups

The first group:

1. 37 elderly dementia patients at the Memory Clinic of the Chiang Mai Neurological Hospital, including both males and females who were diagnose with dementia by a neuropsychologist and with the following criterions

- 1.1 Between 60-85 years of age
- 1.2 At least a pratom 4 education
- 1.3 Has mild or moderate dementia, with a TMSE score between 10-23 points

1.4 No physical abnormalities that hinder participation in the experiment

1.5 Volunteers to participate in the research

The second group:

1. 37 elderly people in the Chiang Mai Neurological Hospital, including both males and females with no dementia, with the following criterias.

1.1 Between 60-85 years of age.

1.2 At least a pratom 4 education.

1.3 Has no characteristics of cognitive deficiencies with TMSE scores of more than 24 points.

1.4 Has no characteristics of depression with TMHQ depression domain T-score of less than 65.

1.5 Voluntarily participates in the research.

Research Tools

The research used to study composed of 4 tests.

The Rey Auditory Learning Test

The RAVLT consists of 15 words which are concrete nouns in two sets, namely list A an list B (interference)

List A: drum, curtain, bell,

List B: table, ranger, bird,

List A will be tested 5 times, called trial I-V (immediate memory). In each trial, all the words in list A will be read for the subject to hear and afterwards, the subject is asked to recite the word they remember, and is repeated 5 times. Then List B is read out (interference) and the subject asked to recite words they remember (proactive interference). Then Trial VI is administered immediately, asking the subject to remember words in list A (retroactive interference). After 30 minutes, the subjects are asked to recall words on list A (trial VII) again. After that recognition is done by reading 30 words and asking the subject to identify whether the word belong to list A, true or false.

The Thai Mental State Examination (TMSE)

The TMSE was developed by the Train the Brain Forum Thailand as a screening test to distinguish dementia in the general population. The test is administered to subjects who must answer the questions and complete the test, taking about 10-15 minutes, with a total of 30 points, with a cutoff point of 23 (scores lower than 23 are considered to have dementia). Those severe depression have scores between 25 – 30. The cutoff score for this research is 27 points in order to increase the sensitivity value to match the score of Kulkull (41). The TMSE separates its variables to six cognitive functions.

1. Orientation (6 points)
2. Registration (3 points)
3. Attention (5 points)
4. Calculations (3 points)
5. Language (10 points)
6. Recall (3 points)

The value of test' quality are mean score of 27.38 and a standard deviation of 2.022.

The Thai Mental Health Questionnaire (TMHQ)

Developed by Sucheera Phattharayuttawat and colleagues. a tool that uses a five point scale totaling 70 questions, developed to diagnosed the mental health of the general population. The test takes about 10 -15 minutes, with scores given between 1 -5 points. The test measured variables in 5 aspects of mental health (41) namely,

1. Somatization
2. Anxiety
3. Depression
4. Psychotic
5. Social Function

The quality of the test in terms of validity and reliability of the TMHQ for psychotic patients, uses a total of 1,205 subjects (503 men, 702 women, between 12-74 years old), with results for the Cronbach's Alpha Coefficient between 0.82-0.94.

The test also had a concurrent validity study to find the relationship between the Brief Psychiatric Rating Scale (BPRS) and the General Health Questionnaire, which results suggest that the TMHQ is beneficial and is appropriate for the use with this group of the population.

Research Procedures

The research had two stages in the procedures as follows

1. Test studying stage, translating and arranging words in the words list by considering the Greek and Brazilian versions of the test(43,44). Additionally, socio-cultural considerations for Thailand must be taken into consideration using the following guideline

- direct translation

- in the case where the definition is askew, a new word will be chosen that is familiar to Thai people in order to reduce the cultural barrier. The principle is to choose 2-3 syllable words which are concrete nouns and all the words in the same list must not be related or similar to each other in terms of sound and meaning. Additionally, it must be a word that is commonly used in everyday speech and does not exceed third grade education.

- The difficulty of the Thai and English words must appropriately correspond with each other.

Consult validators and check test tool as well, including 2 clinical psychologists, 2 psychologist working in neuropsychology, a Thai instructor, 2 English instructor, and a native English teacher who understands Thai.

2. Data collection

The test was administered to both groups using individual tests starting in June 2008 to January 2009, which include the following procedure.

2.1 Meet with the sample group to introduce the project and build a good relationship, and ask for their cooperation by briefing the objectives of the study and benefits of the research.

2.2 Ask the patient history according to the personal information questionnaire.

2.3 Individual testing of the TMSE, TMHQ, and RAVLT

2.4 Data collection from the RAVLT

Data Analysis and statistics

The data collected will be analyzed using the following procedure

1. Descriptive Analysis

1.1 Descriptive analysis of data on sex, age, level of education, and diagnosis by percentage and frequency

2. T-Test and Mann Whitney-U Test

2.1 The calculation of mean and standard deviation between regular elderly and demented elderly analyzed the difference between their respective scores using the t-test and Mann Whitney – U test.

2.2 Analyze scores for each aspects for groups between 60-60 and 70 and above, using the t-test and Mann Whitney – U test for both groups.

2.3 Analyze scores for each aspect for groups with different level of education, elementary and middle school education for both groups using the t-test and Mann Whitney-U test.

2.4 Analyze the difference between primacy and recency in the regular group using the paired t-test.

2.5 Analyze the difference between primacy and recency in the demented group using the paired t-test.

2.6 Analyze the difference between recency and middle in the demented group using the paired t-test.

CHAPTER IV

RESEARCH RESULTS

This is a descriptive study to study of the scores of the RAVLT in demented elderly people compared with normal elderly people and study the problems of the limitations, and approaches in using the RAVLT with Thai people. This study included a sample of 74 people, separated into a group of demented elderly patients in the memory clinic in the Chiang Mai Neurological Hospital (37 patients) and elderly people in the elderly people society at the Chiang Mai Neurological Hospital (37 patients). The researcher has used the results of this study to analyze statistically, and will present results of the data as follows.

Part 1 General characteristics of the sample group

Part 2 Results from the RAVLT in control participants and demented elderly people

Part 3 Comparison of the results from the RAVLT in control participants and demented elderly people

Part 1 General Characteristics of the Sample Group

Table 1 Showing the number and percentage in control participants and demented elderly people categorized by sex, age and level of education

General Information	Dementia Patients		Normal People		P -value*
	Frequency	Percentage	Frequency	Percentage	
Gender					
Male	19	51.4	13	35.1	0.2407
Female	18	48.6	24	64.9	
Age (years)					
60 – 64	3	8.1	10	27.0	0.2515
65 – 69	9	24.3	6	16.2	
70 – 74	8	21.6	8	21.6	
75 – 79	7	18.9	7	18.9	
80 and over	10	27.0	6	16.2	
Education					
Primary School	21	56.8	14	37.8	0.2133
Secondary school	11	29.7	18	48.6	
Bachelor Degree	5	13.5	5	13.5	

*p-value from Chi-square test

Table 1 shows the number of samples found that there are more male demented elderly than females, while there are more females than males. Upon consideration of age, it was found that the group with the highest instance of dementia is 80 years or older, and the most common age of the normal elderly group is between 60-64 years old. Nevertheless, the most common age in both groups there was only

about 40.5% of samples in the 70-79 year group. In terms of level of education, it was found that more than half of demented elderly people had elementary education, and normal elderly people had high school education, and when the proportion of the personal data is tested for both groups using the variables of sex, age and level of education, it was found that there were no significant statistical significance (p-value =0.2407,0.2515,0.2133 respectively)

Table 2 Showing the lowest and highest values, mean and standard deviation of age for the normal and demented elderly

Sample Group	Lowest Value	Highest Value	Mean (\bar{x})	S.D.
Normal Elderly	60	87	71.35	7.70
Demented Elderly	60	86	73.76	7.14

Table 2 showing the mean values of the sample groups found that both groups have a similar mean age of 71.35 years for the normal elderly and 73.76 years for the demented elderly.

Table 3 Showing the number and percentage of the demented elderly separated by diagnosis

Diagnosis	Frequency	Percentage
Alzheimer's disease (AD)	25	67.6
Vascular dementia (VAD)	8	21.6
Alcoholic dementia (alcohol)	4	10.8

Table 3 Showing the number and percentage of the demented elderly separated by diagnosis found that the most common diagnosis is Alzheimer's disease, followed by Vascular dementia and alcoholic dementia respectively.

Part 2 Results from the RAVLT in control participants and demented elderly people

Table 4 Showing the lowest and highest values, mean (\bar{x}) and standard deviation (S.D.) of the scores in test in the normal elderly

RAVLT Score	Minimum	Maximum	Mean (\bar{x})	S.D.
Trial I	2	13	5.54	1.91
Trial II	5	13	7.86	1.86
Trial III	6	14	9.51	1.76
Trial IV	6	14	10.57	1.97
Trial V	4	14	11.35	2.28
Trial B	3	8	5.65	1.64
Trial VI	3	14	8.76	2.97
Trial VII	4	15	9.22	2.68
Trial I-V total	26	61	44.84	7.64
Proactive interference	-1	11	5.70	2.50
Retroactive interference	-2	7	2.59	2.13
Primacy	6	22	15.84	3.61
Middle	0	19	12.70	4.24
Recency	9	24	16.35	4.17
Hit	9	15	14.22	1.25
Cr	9	15	14.11	1.51
Fp	0	6	0.89	1.51
Miss	0	6	0.78	1.25
Repetition	0	39	7.76	7.29
Error	0	6	0.51	1.33
Error association	0	5	0.68	1.16

Table 5 Showing the lowest and highest values, mean (\bar{x}) and standard deviation (S.D.) of the scores in test in the demented elderly

RAVLT Score	Minimum	Maximum	Mean (\bar{x})	S.D.
Trial I	0	6	2.68	1.55
Trial II	1	8	4.14	1.89
Trial III	0	10	4.84	2.30
Trial IV	0	10	5.11	2.09
Trial V	2	11	5.54	2.08
Trial B	0	6	2.86	1.80
Trial VI	0	11	2.00	2.47
Trial VII	0	11	1.35	2.35
Trial I-V total	7	42	22.30	8.46
Proactive interference	-2	8	2.68	2.11
Retroactive interference	-1	9	3.54	2.10
Primacy	0	21	6.62	5.32
Middle	0	14	4.46	3.40
Recency	4	22	11.16	4.75
Hit	0	15	10.41	4.51
Cr	0	15	10.14	4.75
Fp	0	15	4.59	4.49
Repetition	0	12	2.19	2.61
Error	0	18	1.41	3.35
Error association	0	12	1.35	2.36

Table 6 Comparison of the difference in RAVLT scores of the normal elderly with and elementary and middle school education or higher

RAVLT Score	Elementary		Middle School or higher		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Trial I	4.57	1.40	6.13	1.96	0.009 ^(b)
Trial II	7.07	0.83	8.35	2.14	0.066 ^(b)
Trial III	8.79	1.37	9.96	1.85	0.048 ^(a)
Trial IV	10.07	1.59	10.87	2.14	0.231 ^(b)
Trial V	10.64	1.69	11.78	2.50	0.039 ^(b)
Trial B	4.86	1.56	6.13	1.52	0.022 ^(b)
Trial VI	7.57	2.24	9.48	3.16	0.049 ^(b)
Trial VII	8.43	1.99	9.70	2.96	0.138 ^(b)
Trial I-V total	41.14	4.90	47.09	8.21	0.019 ^(a)
Proactive interference	5.79	1.93	5.65	2.84	0.878 ^(a)
Retroactive interference	3.07	1.94	2.30	2.22	0.294 ^(a)
Primacy	13.93	3.50	17.00	3.22	0.010 ^(a)
Middle	12.64	3.23	12.74	4.83	0.948 ^(a)
Recency	14.64	3.99	17.39	4.01	0.050 ^(a)
Hit	14.07	1.54	14.30	1.06	0.610 ^(b)
Cr	13.93	1.33	14.22	1.62	0.328 ^(b)
Fp	1.07	1.33	0.78	1.62	0.328 ^(b)
Miss	0.93	1.54	0.70	1.06	0.610 ^(b)
Repetition	6.50	4.64	8.52	8.52	0.699 ^(b)
Error	0.29	0.73	0.65	1.58	0.610 ^(b)
Error association	0.71	1.14	0.65	1.19	0.889 ^(b)

(a) t-test

(b) Mann-Whitney U test

Table 6 found that scores from Trial I, Trial III, Trial V, Trial B, Trial VI, Trial I-V total, Primacy and Recency are different between both groups of normal elderly with elementary and high school education or above, whereby elderly people with high school education or above had scores for Trial I, Trial III, Trial V, Trial B, Trial VI, Trial I-V total, Primacy and Recency higher than elderly people with elementary education with a statistical significance of .05.

Table 7 Comparison of the difference in RAVLT scores of the demented elderly with and elementary and middle school education or higher

RAVLT Score	Elementary		Middle School or higher		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Trial I	2.24	1.22	3.25	1.77	0.068 ^(b)
Trial II	3.90	1.79	4.44	2.03	0.354 ^(b)
Trial III	5.00	1.90	4.63	2.80	0.630 ^(a)
Trial IV	4.62	1.72	5.75	2.41	0.104 ^(a)
Trial V	5.29	2.00	5.88	2.19	0.421 ^(b)
Trial B	2.29	1.65	3.63	1.75	0.023 ^(a)
Trial VI	1.76	2.21	2.31	2.82	0.596 ^(b)
Trial VII	1.00	1.61	1.81	3.06	0.534 ^(b)
Trial I-V total	21.05	7.07	23.94	9.99	0.310 ^(a)
Proactive interference	3.00	2.32	2.25	1.77	0.495 ^(b)
Retroactive interference	3.52	2.23	3.56	2.00	0.868 ^(b)

Table 7 Comparison of the difference in RAVLT scores of the demented elderly with and elementary and middle school education or higher (cont.)

RAVLT Score	Elementary		Middle School or higher		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Primacy	6.57	4.72	6.69	6.18	0.949 ^(a)
Middle	3.95	3.43	5.13	3.36	0.306 ^(a)
Recency	10.52	4.35	12.00	5.25	0.356 ^(a)
Hit	11.24	3.95	9.31	5.07	0.338 ^(b)
Cr	9.24	5.01	11.31	4.25	0.185 ^(b)
Fp	5.76	5.01	3.06	3.26	0.056 ^(a)
Miss	3.76	3.95	5.69	5.07	0.338 ^(b)
Repetition	2.24	2.79	2.13	2.45	0.964 ^(b)
Error	1.76	4.19	0.94	1.73	0.774 ^(b)
Error association	1.10	1.58	1.69	3.14	0.964 ^(b)

(a) t-test

(b) Mann-Whitney U test

Table 7 found that scores for almost all aspects displayed no difference between normal and demented elderly people with elementary and high school education or above, except for Trial B, where demented elderly people with high school education or above have a statistically significant higher score at .05

Table 8 Comparison of RAVLT scores difference between 2 groups of normal elderly namely ages between 60-69 years and 70 years and above

RAVLT Score	60 – 69 years old		70 years and above		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Trial I	6.00	2.25	5.19	1.57	0.294 ^(b)
Trial II	8.81	2.26	7.14	1.06	0.035 ^(b)
Trial III	10.25	1.98	8.95	1.36	0.024 ^(a)
Trial IV	11.31	2.21	10.00	1.58	0.032 ^(b)
Trial V	12.19	1.56	10.71	2.55	0.050 ^(a)
Trial B	6.19	1.52	5.24	1.64	0.083 ^(b)
Trial VI	10.44	2.87	7.48	2.38	0.001 ^(b)
Trial VII	10.50	2.73	8.24	2.23	0.009 ^(a)
Trial I-V total	48.56	8.19	42.00	5.93	0.008 ^(a)
Proactive interference	6.00	1.93	5.48	2.89	0.457 ^(b)
Retroactive interference	1.75	2.14	3.24	1.92	0.033 ^(a)
Primacy	17.81	2.59	14.33	3.60	0.002 ^(a)
Middle	14.06	3.84	11.67	4.33	0.089 ^(a)
Recency	16.63	4.57	16.14	3.94	0.733 ^(a)
Hit	14.50	0.82	14.00	1.48	0.267 ^(b)
Cr	14.50	1.32	13.81	1.60	0.095 ^(b)
Fp	0.50	1.32	1.19	1.60	0.095 ^(b)
Miss	0.50	0.82	1.00	1.48	0.267 ^(b)
Repetition	10.38	9.74	5.76	3.85	0.090 ^(a)
Error	0.69	1.35	0.38	1.32	0.387 ^(b)
Error association	0.94	1.44	0.48	0.87	0.387 ^(b)

(a) t-test

(b) Mann-Whitney U test

Table 8 found that scores for Trial II , Trial III, Trial IV, Trial V, Trial VI, Trial VII, Trial I-V total and Primacy are different for normal elderly between 60-69 years old and 70 years old and older, whereby normal elderly 60-69 year old elderly have a statistically significant higher score by .05.

Table 9 Comparison of RAVLT score difference between 2 groups of demented elderly namely ages between 60-69 years and 70 years and above

RAVLT Score	60 – 69 years old		70 years and above		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Trial I	3.50	2.02	2.28	1.10	0.066 ^(b)
Trial II	4.17	2.25	4.12	1.74	0.810 ^(b)
Trial III	5.17	3.04	4.68	1.91	0.618 ^(a)
Trial IV	5.83	2.52	4.76	1.81	0.378 ^(b)
Trial V	6.67	2.61	5.00	1.55	0.057 ^(b)
Trial B	3.58	2.23	2.52	1.48	0.089 ^(b)
Trial VI	3.25	3.22	1.40	1.80	0.077 ^(b)
Trial VII	2.42	3.63	0.84	1.18	0.413 ^(b)
Trial I-V total	25.33	11.37	20.84	6.41	0.222 ^(a)
Proactive interference	3.08	2.07	2.48	2.14	0.181 ^(b)
Retroactive interference	3.42	2.87	3.60	1.68	0.575 ^(b)
Primacy	7.42	6.56	6.24	4.72	0.536 ^(a)
Middle	5.92	4.40	3.76	2.63	0.138 ^(a)
Recency	11.92	4.64	10.80	4.86	0.511 ^(a)
Hit	10.25	4.31	10.48	4.68	0.737 ^(b)
Cr	12.00	3.36	9.24	5.11	0.133 ^(b)

Table 9 Comparison of RAVLT score difference between 2 groups of demented elderly namely ages between 60-69 years and 70 years and above (cont.)

RAVLT Score	60 – 69 years old		70 years and above		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Fp	3.00	3.36	5.36	4.82	0.137 ^(a)
Miss	4.75	4.31	4.52	4.68	0.737 ^(b)
Repetition	3.33	3.73	1.64	1.70	0.240 ^(b)
Error	1.33	2.57	1.44	3.71	1.000 ^(b)
Error association	1.00	1.60	1.52	2.66	0.713 ^(b)

(a) t-test

(b) Mann-Whitney U test

Table 9 found that there is no score difference in the test between demented elderly between 60-69 years and 70 years and above

Table 10 Testing the difference between Primacy and Recency values in the normal group

RAVLT Score	Mean (\bar{x})	S.D.	t	p - value
Primacy	15.84	3.61	-0.535	0.596
Recency	16.35	4.17		

Table 10 found that there are no significant statistical difference at 0.05 between the Primacy and Recency values using the paired t – test

Table 11 Testing the difference between the Primary and Recency values of demented elderly

RAVLT Score	Mean (\bar{x})	S.D.	t	p - value
Primacy	6.62	5.32	-3.714	0.001
Recency	11.16	4.75		

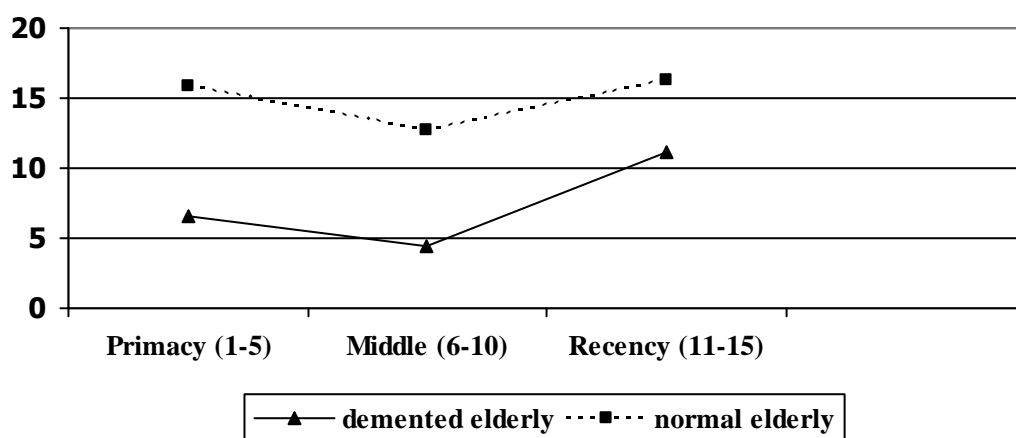
Table 11 found that Recency scores were higher than Primacy scores for demented elderly with a statistical significance of 0.05 using the paired t – test.

Table 12 Testing the difference between Recency and Middle values in the demented

RAVLT Score	Mean (\bar{x})	S.D.	t	p - value
Middle	4.46	3.40	-7.601	<0.001
Recency	11.16	4.75		

Table 12 found that amongst demented people Recency scores were higher than Middle scores with a statistical significance of 0.05 using a paired t – test.

Figure 4.1 Mean performance of the Serial position between normal elderly groups and demented patients



Part 3 Comparison of the results from the RAVLT between normal elderly and demented

Table 13 Comparison of the difference between RAVLT scores of demented and normal elderly

RAVLT Score	Demented Elderly		Normal Elderly		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Trial I	2.68	1.55	5.54	1.91	<0.001 ^(b)
Trial II	4.14	1.89	7.86	1.86	<0.001 ^(b)
Trial III	4.84	2.30	9.51	1.76	<0.001 ^(a)
Trial IV	5.11	2.09	10.57	1.97	<0.001 ^(b)
Trial V	5.54	2.08	11.35	2.28	<0.001 ^(b)
Trial B	2.86	1.80	5.65	1.64	<0.001 ^(b)
Trial VI	2.00	2.47	8.76	2.97	<0.001 ^(b)
Trial VII	1.35	2.35	9.22	2.68	<0.001 ^(b)
Trial I-V total	22.30	8.46	44.84	7.64	<0.001 ^(a)
Proactive interference	2.68	2.11	5.70	2.50	<0.001 ^(a)
Retroactive interference	3.54	2.10	2.59	2.13	0.075 ^(b)
Primacy	6.62	5.32	15.84	3.61	<0.001 ^(a)
Middle	4.46	3.40	12.70	4.24	<0.001 ^(a)
Recency	11.16	4.75	16.35	4.17	<0.001 ^(b)
Hit	10.41	4.51	14.22	1.25	<0.001 ^(b)
Cr	10.14	4.75	14.11	1.51	<0.001 ^(b)
Fp	4.59	4.49	0.89	1.51	<0.001 ^(b)
Miss	4.59	4.51	0.78	1.25	<0.001 ^(b)
Repetition	2.19	2.61	7.76	7.29	<0.001 ^(b)

Table 13 Comparison of the difference between RAVLT scores of demented and normal elderly (cont.)

RAVLT Score	Demented Elderly		Normal Elderly		p - value
	Mean (\bar{x})	S.D.	Mean (\bar{x})	S.D.	
Error	1.41	3.35	0.51	1.33	0.167 ^(b)
Error association	1.35	2.36	0.68	1.16	0.243 ^(b)

(a) t-test

(b) Mann-Whitney U test

Table 13 found that scores for almost all aspects in the test were different between the normal and demented elderly, whereby normal elderly had higher scores in almost all aspects with a statistical significance of 0.05 except in terms of Fp and Miss where demented elderly scored higher with a statistical significance of 0.05. No difference were found between the normal elderly and demented elderly in terms of retroactive interference, error and error association.

Figure 4.2 Mean performance of the RAVLT scores between normal elderly groups and demented elderly

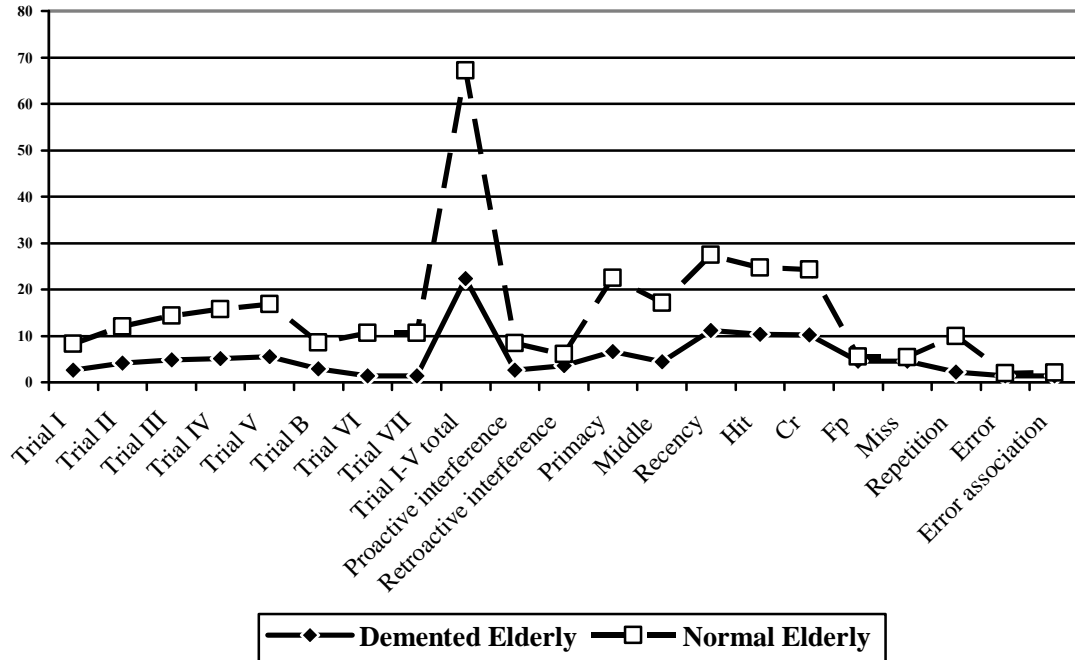
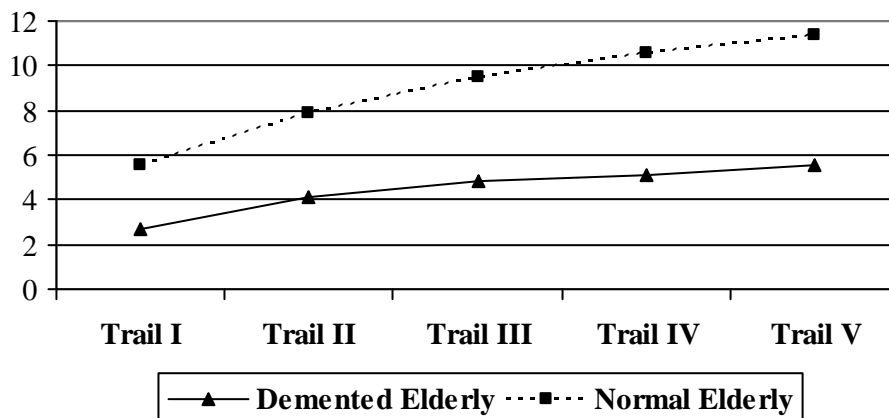


Figure 4.3 Mean performance of the learning curve between normal elderly groups and demented elderly



CHAPTER V

DISCUSSION, CONCLUSION AND RECOMMENDATION

This is descriptive study with objective of studying the structure of RAVLT scores in elderly people with dementia compared with regular elderly people, as well as study the problems of the limitations and the approaches in using the RAVLT with Thai people. This study uses a total sample group of 74 people separated into one group of 37 elderly people with dementia at the Memory Clinic Chiang Mai Neurological Hospital and another group and another group of 37 elderly people in the Chiang Mai Neurological Hospital elderly people club.

The tool used in this research is the Rey Auditory Verbal Learning Test which measures ability in verbal memory, individual information retention and data analysis is done using a computer program to calculate percentages, averages, standard deviation, dispersal, and score comparison using the t-test and Mann Whitney-U test.

Research Discussion

In terms of personal information of the sample group, it was found that there were more male demented elderly than females, whereas the normal elderly group had a larger female representation. In both groups, most of the sample was between 70-79 years old. In terms of level of education, it was found that demented elderly people had elementary education and the normal group had middle school to high school education. Nevertheless, the test variables in terms of sex, age, and level of education had no significant statistical difference.

1. In the comparison of RAVLT results between normal elderly and demented elderly, it is found that normal elderly had higher scores in almost all areas than demented elderly with a statistical significance of .05 namely Trial I, Trial II, Trial III, Trial IV, Trial V, Trial B, Trial VI, Trial VII, Trial I-V total, Hit, Correct Response and Repetition. The scores of false positive and miss in demented elderly were higher than the normal elderly with a statistical significance of .05 excepting in the part of proactive interference, retroactive interference, error and error association,

where it was found that there was no statistical significant difference found between both groups. Additionally, in remembering the order of words from the list, it was found that the normal elderly recalled more words in the beginning and end of the list, that is they have both primacy and recency effect. As for the demented elderly, it was found that they remembered words toward the end of the list better than other parts, that is they only have recency effect.

The results of the demented elderly showed they have lower verbal memory skills than normal elderly people which fits the standard and correspond with the study of Zec which states that dementia is a chronic neurological disease, and continues its progression reducing cognitive ability, abnormalities which can be found with the use of brain (4) and memory tests (45). This is especially the case for early stages of disease progression. Alzheimer patients will have significantly lower scores in test of episodic memory, in the part of delayed recall when compared with other cognitive aspects (46). Mitchell found that almost all types of dementia patients will also have episodic memory dysfunction (8). Lishman, Sigren, Stegnel found that memory dysfunctions often occur in the progression of Alzheimer's, where patients will have problems learning new things and have problems recalling and remote memory. Additionally, Morris also found that Alzheimer patients have memory dysfunctions where they easily forget things, and have worse consolidation and incidental learning (31). The study of Schoenberg among close head TBI, neoplasm, stroke, dementia of Alzheimer type, presurgical epilepsy left seizure focus, presurgical epilepsy seizure focus patients and psychiatric group without any neurological diseases, found that RAVT scores are able to distinguish Alzheimer patients from psychiatric groups(47). Additionally, Gonzalez and colleagues also reported in a study of subjective memory complaints (SMC) totaling 116 individuals by using a battery of neuropsychological tests followed longitudinally for 2 years and found that RAVLT, which is one of the neuropsychological tests, was able to predict the progression into Alzheimer's disease in the future from a score in Trial VI of 0 (48).

In the study of Butters, Wolfe, Martone, Granholm & Cermak, Mungas Squire & Shimamura found that RAVLT scores will be lower in patients such as those with memory and learning disabilities. Bigler, Rosa, Mitrushina, Satz and Van Gorp found that Alzheimer patients in the initial stages will have very low RAVLT scores in

Trial I and Trial V with a score of about 6. Furthermore, Woodard, Dunlosky and Salthouse also found that this group had difficulty in recall (trial VI) after the interference trial (Trial B) and also have characteristics of answering words that are not in the list (error) (8).

Balthazar M.L.F and colleagues reported in a study of Mild Cognitive Impairment (MCI) and mild Alzheimer's disease have impairment in episodic memory tests (RAVLT) especially in delayed recall task (Trial VII) which in the MCI have average scores of 4.26 ± 2.54 . Mild AD have score between 1.00 ± 1.25 and the control group with scores 9.40 ± 3.20 which is similar to the results in this study. Nevertheless no difference was found in terms of semantic memory in the MCI and control group (49).

In the part of the results of the scores from Trial I and Trial VII which are similar with this study including the study of Klimkowicz-Mrowiec in the group of Mild AD which scores in Trial I 2.5 (SD=1.54), Trial VII 1.05 (SD=1.63), moderate AD score Trial I 2.13 (SD=1.63), Trial VII 0.19 (SD=0.75) and the control group with average scores in Trial I at 4.67 (SD=1.93), Trial VII (SD=3.21) (50).

In terms of scores for recognition, it was found that there are studies that have similar results to this one, namely Gainotti and Mara which found False Positive as the separator of normals and depressive pseudodementia patients from AD, whereby in the normal group, there are no false positive scores and only 15% of depressive pseudodementia patients will have a score of more than 2, but among AD patients, it was found that 81% have more than 2 false positive answers(34).

Additionally, Van Gorp, Mirushina and colleagues also found that False Positive scores were 8.4 (SD=5.7) in AD, 1.8 (SD=2.1) in AIDS dementia patients, 1.6 (SD=2.1) in normal elderly individuals. Moreover, Tierney reported finding of false positive at 3.6 for moderate AD, 4.5 in severe AD, 2.2 in Parkinson's dementia and 0.3 in normal(34).

In the part of recalling words in the order of the list, Bernard, Geffen, Mitrushina, Taylor, Tierney found that normal elderly individuals had both primacy and recency effects, that is they are remember words from the beginning and end of the list. Conversely, demented elderly individuals have only recency effect (33,34). From the study of Britt of a sample group of 127 patients consisting of dementia,

psychiatric , general medicine, head injury, recency was only found among dementia patients (51)

Nevertheless, in this study, no score differences were found for proactive interference and retroactive interference, calculated from scores from trial I-Trial B, whereby average scores for Trial I and Trial B are similar for both group, specifically, demented patients Trial I=2.68, Trial B=2.86 and normal elderly Trial I=5.54 Trial B=5.65 making no difference on the results. Nevertheless, the scores is able to tell whether the immediate memory span for words in demented patients are lower than normal elderly individuals. This corresponds with the study of Tierney which found the norm in healthy adult males aged between 13-79 had scores for trial I between 6.8 and 5.5, depending on age. In moderately impaired Alzheimer's disease patients, scores for Trial I were only 2.7 (SD=2.1)(33,37), Retroactive interference scores can also be explained, such that retroactive interference is calculated from trials V-trial VI and indicate the ability for new information retention and retrieval. Although this study did not find any difference in terms of retroactive interference in either groups, but when considering the score details it can be found that demented patients have problems with retention of new information and retrieval, that is scores in trial VI were lower than in trial V, more than normal elderly individuals, with an average value at 3.54 and 2.59.

When comparing scores for error and error association, no significant difference was found for either group, but when considering the scores themselves, it is found that error and error association in normal elderly individuals, which is rare or does not exist with scores at 0.51 and 0.68 respectively. This is similar to the error scores reported by Geffen, Moar, O'Hanlon that elderly individuals between 60-69 had an average of 0.7 in women and men 0.3, and in the 70 and above group, error averaged at 0.5 in women, and 0.9 in men(33,34). This study found that the demented elderly had average error and error association values higher at 1.41 and 1.35 respectively, which explains that the tendency for semantic or phonetic confusion that is a confabulatory response in demented patients is higher than normal elderly individuals.

2. Comparing RAVLT scores of normal elderly individuals at different age groups found that those between 60-69 had higher scores than those in the 70 and

above group at a statistical significance of .05 for Trials II, Trial III, Trial IV, Trial VI, Trial VII, Trial I-V total and primacy, which corresponds with the assumption and study of Eustache and colleagues who found that an elderly brain will have deterioration in the part of the temporal cortex, hippocampus, and limbic system, which are all responsible for memory. Aging is correlated with the deterioration of memory, cognitive function, reaction time, and other functions. Additionally, the development of neurodegenerative disease is correlated with age, such as Alzheimers has a 50% frequency among 80-90 year olds, which can be stated that this is the results of the aging brain (52). Schofield studied elderly in a community without problems in terms of cognitive, and found that 31% reported memory problems. Foo & Wright, Salthouse found that age affects memory changes, and when affects short-term memory which includes immediate recall and working memory as well (31). Vakil and Blachstein studied the Hebrew version of the RAVLT and also found moderate difference between the less than 60 years and above 60 years group for scores in Trial v, Trial I-V, Trial B, and Trial VI (8). Moreover, Graf, Uttl & Tuokko studied normal elderly people between 65-95 and found significant difference for scores from trial I-V total and trial B (34).

3. RAVLT scores comparison of normal elderly individuals at the elementary and high school education (or above) showed that elderly people with a high school education will have higher scores for Trial I, Trial III, Trial V, Trial B, Trial VI, Trial I-V total and primacy. This corresponds with the assumption and study of Geffen and colleagues who found a relationship between the scores for Trial I-V. Nevertheless, in terms the correlation of level of education to RAVLT scores, there is only a moderate correlation (34).

4. RAVLT scores comparisons for demented elderly individuals with different level of education found no difference in all parts of the test with any significant statistical difference at .05 between demented individuals with difference age groups or level of education, which can be explained that dementia is a chronic neurodegenerative disease, and has a steady progression, allowing the cognitive to slowly to the extent that it affects other brain functions to point where age and level of education has no effect on test results.

Research Conclusions

1. The sample group used in this study totaled 74 individuals who are 60 years or older, separated into two groups consisting of 37 normal elderly individuals, and 37 demented elderly individuals. In terms of personal information, it was found that there were more male demented elderly than female, whereas the normal elderly has more females than males. Both groups were mostly between 70-79 years old. In terms of level of education, it was found that most demented elderly people had an elementary education and the normal elderly group had a high school education. Nevertheless, when the personal data is tested in terms of sex, age and level of education, it was found that no significant statistical differences were found.

2. The comparison of results from the RAVLT between normal elderly individuals and demented elderly people using the t-test and Mann-Whitney-U test found that normal elderly people had statistically significant higher scores at .05.

3. In the comparison of the difference between RAVLT scores in the two normal elderly groups, namely aged between 60-69 and 70 and above, it is found that scores for Trial II, Trial III, Trial IV, Trial VI, Trial VII, Trial I-V total and primacy, whereby the 60-69 years group had statistically significant higher scores at .05 compared to the 70 and above group.

4. The comparison of RAVLT scores among normal elderly with elementary and high school education or higher, it was found that scores for Trial I, Trial III, Trial V, Trial B, Trial VI, Trial I-V total and primacy had a difference between these two groups, whereby those with a high school education had statistically significant higher scores at .05 compared to those with elementary education.

5. The comparison of RAVLT scores of demented elderly people with different levels of education displayed no difference at a statistical significance of .05 between demented elderly people with different age and education levels.

Limitation and Applications of the RAVLT

1. The RAVLT is an approach to help decide which verbal memory test to use because it is concise, simple and does not disturb the recipient.
2. The venue of the test must be a peaceful place void of distraction because it is a memory test that depends on listening, and should be careful to control the environment from distraction the concentration of the recipient.
3. The test requires a loud and clear voice, observing the behavior of the recipient as to whether they understand the instruction or have anxiety. A relationship of trust should be created and put the recipient in a relax and comfortable state.
4. In Trials VI and VII, do not display rushed behavior when the recipient is unable to recall the words, but they should be encouraged such as slowly thinking through, this will the recipient who has anxiety better respond to the test.
5. During the 30 minute delay, care must be taken not to administer any similar verbal memory test because it can disturb with the results of the test, but instead use visual memory tests.

Recommendation and suggestions for future research

1. There should be a specific study for specific dementia diseases such as Alzheimer's disease, vascular dementia, frontal lobe dementia, in order to study the scores structures, as well as study other brain pathologies as well.
2. There should be a study on a larger sample group, as well as for different age groups and levels of education to build standard criterion for Thai people.

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APPENDICES

APPENDIX A

List of validators

1. Associate Professor Kanokrat Sukhatunga
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8. Miss Akanitha Seeboonruang
Neuroscience Center, Bangkok Hospital Medical Center.

APPENDIX B

Example of the instrument.

คำที่	List A	
1	DRUM	กลอง
2	CURTAIN	ผ้า幔
3	BELL	กระดิ่ง
4	COFFEE	กาแฟ
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Example of the instrument (cont.)

คำที่	List B	
1	DESK	โต๊ะ
2	RANGER	ตำรวจ
3	BIRD	นก
4	SHOE	รองเท้า
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Example of the instrument (cont.)

คำที่	Recognition	
1	TEACHER	ครู
2	RIVER	แม่น้ำ
3	BRIDGE	สะพาน
4	FARMER	ชาวนา
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BIOGRAPHY

NAME	Mrs. Darunee Montientong
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