EPISODIC, WORKING AND SEMANTIC MEMORY IN 60-70 YEAR OLD NEURO -TYPICAL INDIVIDUALS

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Registration No: 14SLP031

A Dissertation Submitted in Part Fulfilment of Degree of Master of Science

(Speech-Language Pathology)

University Of Mysore

Mysore

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May, 2016

CERTIFICATE

This is to certify that the dissertation entitled **"*Episodic, Working and Semantic memory in 60-70 year old Neuro-typical individuals*"** is the bonafide work submitted in part fulfillment for the degree of Master of Science (Speech-Language Pathology) of the student (Registration No.14SLP031). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CERTIFICATE

This is to certify that the dissertation entitled **"*Episodic, Working and Semantic memory in 60-70 year old Neuro-typical individuals*"** has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier to any other University for the award of any Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **"*Episodic, Working and Semantic memory in 60-70 year old Neuro-typical individuals*"** is the result of my own study under the guidance of Dr. R. Rajasudhakar, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not submitted earlier to any other University for the award of any Diploma or Degree.

Mysore **Register No: 14SLP031**

May , 2016

Dedicated To My Dear Lord Ganesha, Amma And Appa

Acknowledgement

To begin with, if god exists then it's only in the form of parents. Amma and Appa I'm blessed to have amazing parents in my life. As a daughter, I see immense love through you both which makes my heart feel happy all the time. You both are not only best parents, also my best friends, incomparable guide. When I completed my data collection first in whole class, all my classmates were surprised as how did she complete so soon!! My friends now I reveal my secret of completing data collection so soon is all because of parents support. Without their succor I' am nothing. Here I get an opportunity to gratitude to my beloved parents. I love Amma and Appa more than I love myself ☺

Secondly, I convey fervent gratitude to my guide ***Dr. R. Rajasudhakar.*** *Sir when I approached you for being my guide you easily accepted me as your dissertation student. I am very thankful for accepting me for guiding. Usually people look for perfect seed to grow plant or perfect student for guiding. But you never looked for perfect seed or brainy student. Sir this shows you are perfect guide to guide any kind of students. I was a just a tiny sprout in the field of research. Gradually you provided plenty of light and finally grown into fully fledge plant,*

meaning to say guided each and every step for carrying out research work, starting from selecting topic till the writing part. During this process, there were plenty of situations where you not only guiding related to research work, you also tend to talk about principles of life. I would be more fortune to listen to those principles of life. Most important I learnt is being patience. In spite of busy schedule work, you were spending your value time in clearing doubts from this I learnt to help others even if we are busy with our work. Here I get opportunity to heartfelt gratitude for my guide assisting me throughout dissertation ☺

I also extend my gratitude to my dissertation partners Shruthi. R. V and Potha Soundar Raj for your listening to my worries and motivating whenever I am upset. I'm lucky to have you both as my dissertation partners ☺

Pooja, Rakshitha, Sahana, Vimala, Rashika, Nikitha. K and Suvetha you people were so special for adding colors as well as value to my life ☺ Most important that you people always making smile me when I about lose my smile. Wholehearted thank you friends for inspiring and always being special to me ☺

Chaitra, Darshan and Deepak…special thanks to you people. Frequently you people were enquiring the progress of my work. Trust me to give an answer I would focus on my work which in turn helped to finish my dissertation work quickly. I am very thankful to people for motivating and not letting me to lose my focus ☺

Nikhil and Pankaja…I'm grateful to my school friends as well for listening to my words patiently. Many a times I just blabber regarding my dissertation. You both were giving valuable feedback of my work and appreciating me which in turn boost my energy ☺

I would like to thank author of CLAP-K Aruna Kamath and Dr. S. Venkatesan, Reader & HOD, Department of Clinical Psychology for having developed a tool NIMH Socio-economic status scale, both of which were used in the present study.

I also extend grateful thank you to Dr. Vasantha Lakshmi for assisting me in statistical analysis. And for your the valuable view points on analyzing the results of my data. I also felt lucky when you blessed me during one of the festival occasion.

Lastly I would thank all my participants for taking part in my study. Without your participant my dissertation is incomplete. I enjoyed a lot during data collection as you were sharing your experiences and blessed me as well. There were many amazing moments spending my time with participants. Thank you each one of you ☺

If I have forgot to mention anybody's name, then I thank them as well who ever helped me directly or in directly. Thank you all

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CHAPTER I

INTRODUCTION

Aging is not lost youth, but a new stage of opportunity and strength

Betty Friendan

Aging can be defined as the time progress decline in the physiological functions that are necessary for survival and fertility. According to Hultsch & Deutsch (1981) aging is an elementary biological multidimensional process encompassing physical, psychological, and social change which can be defined, described, measured, and manipulated. However, "Normal aging often refers to the most common or usually encountered functional state of the nervous system in a population of older individuals" (Whitehouse, 1986).

Aging studies have well documented the variation in the following structures such as

- A study by Esiri (2007) reported gradual loses of neurons as well as some of the supporting neuroglial cells were noted in the age range of 20-60 years. Also, neural losses are only around 0.1% per year but thereafter the process tends to speeds up in the age range of 20-60 years.
- The volume of the brain and/or its weight declines with age at a rate of around 5% per decade after age 40 (Svennerholm, Boström & Jungbjer 1997).
- Age related degeneration noted in Subcortical gray matter structures (Long, Liao, Jiang, Liang, Qiu & Zhang, 2012; Jancke, Merillat, Liem & Hanggi, 2015). Also, decrease in cortical volume especially in frontal cortex was associated with aging (Kemper, 1994; Madden & Hoffman, 1997).
- Burke and Barns (2006) quoted significant loses of neural tissue in hippocampus.

- Micro structural changes have been observed significantly in white matter structures and particularly the corpus callosum (Gooijers & Swinnen, 2014).
- The peripheral nerve cells often show increase in degeneration of the myelin sheath (insulatory layer around the axon). Further actual rate of decline probably increasing in the age range of 70 years (Scahill, Frost, Jenkins, Whitwell, Rossor & Fox, 2003).
- In addition it has been documented that;

  a) White matter may decline with age,

  b) The myelin sheath deteriorating occurs around the age of 40 in normal aging. Further, the late myelinating regions of the frontal lobes are most likely to be affected by white matter lesions (Bartzokis, Cummings, Sultzer, Henderson, Nuechterlein & Mintz, 2003).
- The greatest effect occurred in the hippocampus due to aging (Anderton, 2002)
- Moreover, a progressive loss of neural tissue with age was reported which resulted in gradual decline in cognitive function (Montague, 2005).

Thus aging can be divided into Biological aging (Handler, 1960); Psychological Aging (Birren & Renner, 1980) and Cognitive Aging (Bayles, Kaszniak & Tomoeda, 1987; Cohan & Faulkener, 1989).

Cognitive aging is defined as the cognitive changes occur due to aging. Cognition comprises all processes by which can be transform, condense, elaborate, store retrieve, and exploit sensory information and allows an individual to handle with and process incoming information so that it help in understanding and interacting with the environment (Neisser, 1967; Guliford & Hoepfner, 1971). One such component of

cognition is Memory. *"*Memory is the process of maintaining information over time*."* (Matlin, 2005).It is defined as a process whereby what is experienced or learned is established as a record in the Central Nervous System (registration), where it persists with a variable degree of permanence (retention) and can be recollected or retrieved from storage at will (recall). In simpler terms, memory is the ability to recall or recognize earlier experience. The following four processes are found to take place in the storage of memory:

- *Encoding*: Information for each memory is assembled from the different sensory systems and is translated into whatever necessary form to be remembered and stored. This is presumably the domain of the association cortices and other areas.
- *Consolidation*: Converting the encoded information into a form that can be permanently stored. The hippocampus and surrounding area accomplish this.
- *Storage*: The actual deposition of memories into the final resting places. This is thought to be in the association cortex.
- *Retrieval*: The process of gaining access to stored, coded information when needed.

Multi-store model which holds that memory can be divided based on stores or types (Waugh & Norman, 1965; Atkinson & Shiffrin, 1971).

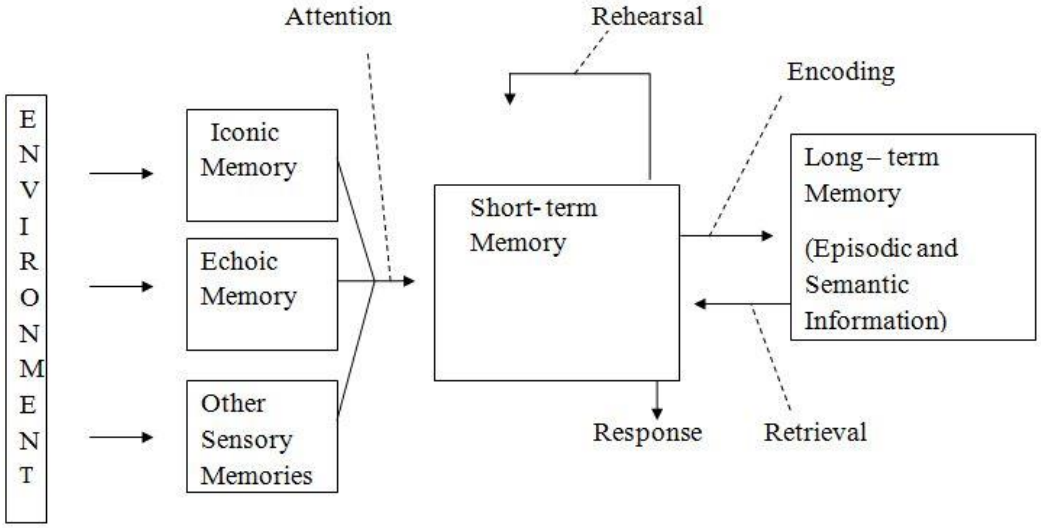

Figure 1 Schematic representation of Multi-store Model of Memory.

Figure 1 shows the schematic representation of Multi-store Model of Memory. According to this model, the human memory system consists of memory structures and control processes. Memory structures were defined as the physical system which is built-in processes that are unvarying and fixed from one situation to another. Control processes were defined as processes that are selected, constructed, and used at the option of the subject and may vary dramatically from one task to another. This model proposed that memory can be understood as sequence of discrete steps, in which information is transferred from one storage area to another. The major physical structures of the system were considered to be the sensory store, short term memory and long term memory.

External stimuli from the environment enter the sensory memory. These stores are modality specific (example: vision, auditory). It can be further divided into iconic memory and echoic memory (Neisser, 1967).

Iconic memory: The visual store is often known as the iconic store. The storage is very useful for two reasons. First, the mechanisms responsible for visual perception always operate on the icon rather than directly on the visual environment. Second, information remains in iconic memory for upwards of 500ms, and we can shift our attention to aspects of the information within iconic memory in approximately 55ms. This helps to ensure we attend to important information.

Echoic memory: It is responsible for auditory perception. The 'echo' that remains in your head after the original sound has ended. This is the actual presence of the sounds in your brain, and it only lasts for 2-3 seconds.

Sensory memory: Information is held very briefly in the sensory stores. It is a large capacity storage system that accurately records information from the different senses, memory decays rapidly in sensory memory. Sensory memory stores information for 2sec or less than forgets. Information in this register is in a form that is subject to rapid loss from memory. According to this, before sensory information can be labelled and recalled, it must be categorized & recognized with long term store. The information is then transferred to short-term store once stimuli in the sensory register are identified by means of already available information in long-term store.

Short term memory (STM): It is also called working memory. The information passes from sensory memory to short term memory. STM contains small amount of information we actually using. If this information not repeated or rehearsed in 30sec they are lost. Memories in STM are fragile. STM contains small amount of information that we are actively using. It may decay rapidly, in about 30 seconds, unless it is rehearsed. Information could also be “bumped out” by new incoming information as well. The rehearsal is a control process that operates on material

present in the short term store, serving to maintain information in this store & also to facilitate transfer to long-term store.

Long Term Memory (LTM): Information rehearsed passes to (LTM). LTM has a large capacity and contains memories that are decades old, in addition to memories arrived recently.

- Information stored in LTM is relatively permanent, and not likely to be lost. The arrow back represents our ability to retrieve information from long term and call it back into short term memory when we want to work actively with the information again.
- While the original information is residing in STM, a copy of the information gets transferred to LTM. Although all information is assumed to be lost eventually from sensory storage and STM, information in LTM is viewed as relatively permanent, despite the fact that it could be rendered temporarily inaccessible or even modified by new incoming information.

The companion piece of the model (Shiffrin & Atkinson; 1969) was concerned with a) Storage and b) Retrieval processes in LTM.

a) Storage supposedly involved 3 mechanisms;

1. *Transfer*: Consists of control processes sorting what to store, when to store, and how to store information in LTM.

2. *Placement*: The placement processes decides where to put the information in LTM. This decision depends largely on nature of the information itself. LTM is considered to be partly self-addressing. Self-addressing proceeds by determining an appropriate, unique storage location based on the makeup of information being processed.

3. *Image production*: It determines what proportion of the information actually gets stored in LTM.

b) Retrieval from the LTM involves three mechanisms;

1. *Search*: The search mechanism determines a location in memory as a likely storage for the desired information; this mechanism is partly self-addressing.

2. *Recovery*: The recovery mechanism determines how much of the information at the current location will be transferred to STM.

3. *Response generation*: Once in the STM the recovered information is examined by the response generator and a decision is made whether to continue the search or to emit a response.

Need for the study

- There is a dearth of empirical data in neuro-typical elderly individuals on cognitive linguistic abilities in Indian context.
- Very limited studies published on cognitive linguistic abilities in Kannada speaking neuro-typical elderly individuals.
- Cognitive Linguistic Assessment Protocol for Adults developed by Kamath (2001) field tested on very few participants (only 6 males and 6 females) in the age range of 60 to 70 years.
- Also, the present study considered certain variables such as socioeconomic status and educational background of participants using NIMH Socioeconomic status scale which was not considered in the previous study by Kamath (2001). Hence, the present study is planned to examine the memory (episodic, working and semantic) skills by including more number of participants in the

age range of 60 to 70 years and consider other variables such as socio-economic status and education level of participants.

Aim of the study:

The aim of the present study is to investigate episodic, working and semantic memory abilities in neuro-typical elderly individuals in the age range of 60-70 years.

Objectives of the study:

The specific objectives of the study are:

- To develop normative data on episodic, working and semantic memory skills in neuro-typical elderly individuals between 60 to 70 years.
- To evaluate the age related changes on episodic, working and semantic memory skills in neuro-typical elderly individuals.
- To compare gender difference (if any) on episodic, working and semantic memory in neuro-typical elderly individuals.
- To compare the performances between episodic, working and semantic memory in neuro-typical elderly individuals.

Totally 101 neruo-typical elderly individuals in the age range of 60-69.11 years were included in the current study. They were divided into two groups i.e, Group I and Group II. Group I consisted of 50 neuro-typical elderly individuals in the age range of 60-64.11 years where as Group II consisted of 51 neuro-typical elderly individuals in the age range of 65- 69.11 years. The episodic, working and semantic memory abilities in neuro-typical elderly individuals were assessed using Cognitive Linguistic Assessment Protocol in Kannada (CLAP-K) developed by Kamath (2001). The scores

of Memory domain were calculated for Group I and Group II separately. Further, group comparisons, comparison between genders were investigated.

Implications of the study

The results of the present study augment the understanding of memory in neuro-typical elderly individuals. It will provide the normative data on episodic memory, working memory and semantic memory in Kannada speaking neuro-typical elderly individuals between 60-70 years. The results of the present study in turn will be useful in assessing and planning therapeutic intervention for elderly individuals.

CHAPTER II

REVIEW OF LITERATURE

The present study compiled the summary of research findings pertaining to the topic under the following headings;

a) Aging and Memory
b) Episodic Memory
c) Working Memory
d) Semantic Memory

a) Aging and Memory

Abundant of studies has been shown the relatively healthy older adults tend to have memory deficits accompanying the aging (Burke & Light, 1981). Memory function can be broadly sub grouped into episodic memory, working memory and semantic memory (Parkin, 1997).

b) Episodic Memory

Episodic memory is a sub group of long-term memory which involves the recollection of specific events, situations and experiences. A study by Craik (1977) who reported the age differences was observed minimally in the immediate recall. Further, in delayed recall, older adults showed poor performance in episodic memory (Petros, Beckwith & Anderson, 1990; Peterson, Rocchi, West, McLellan & Hackney, 1999). A study by Lovden (2003) included 146 participants in the age range of 20 to 80 groups and assessed the domains like processing speed, inhibition, episodic memory performance, and false memory. Results revealed age related differences in episodic memory performance that is attributed to increase while false memories (incorrect recognition).

Dunlosky and Salthouse (1996) assessed age related changes in relative role of acquition and forgetting in multitrial learing as well as free recall trails. The study incorperated 258 adults in the age range of 18-94 years. The age groups were divided into 6 groups (18-29, 30-39, 40-49, 50-59, 60-69, 70-94 years). The Auditory Verbal Learning Test was administered which consist of 15 word list (one critical list and one distractor list). Experimenter read the word from critical list, immediately participants were asked to recall the words as much as possible. Following this task, distractor list was presented. They were asked to recall all the words from the critical list. Authors found that many trails needed for the 60s age group inorder to achieve 70% when compared to 20s age group. Further, age related difference was observered both in gained access and lost access. This is attributed to age difference in learning due to difference in acquisition than forgetting. The study fails to provide insight to the age related decline to processing speed as the test items which they had included fails to tap the processing speed. Also, the authors had divided the group into wider age intervals (example: 18-29) which inturn fails to document the subtle changes in that age range.

Ronnlund, Nyberg, Backman & Nilsson (2005) traced to document the changes in episodic memory by using cross-sectional and longitudinal data. The study comprised of 829 participants in the age range of 35–85 years. The participants were divided into 10 groups with an equal interval of 5 i.e.,35-40, 40-45, 45-50, 50-55, 55-60, 60-65, 65-70, 70-75, 75-80, 80-85. The episodic memory included five different recall such as action recall, recall of verbal and action noun, recognition of verbal noun and recall of statement. The action recall assessed by presenting 16 verbal commands which comprised of nouns and verbs. It had two conditions. In first condition, asked to enact followed by recall. In second condition, they were asked to recall without enacting.

For recall of verbal and action noun, participants were asked to recall as many nouns as possible from the enacted sentences described previously. Recognition of verbal noun was assessed by presenting a list of 32 nouns. These nouns were taken from the enacted or non-enacted sentences, with 8 nouns from each condition (the 16 other nouns were distracters). Recall of statement was assessed by asking 20 questions related to the famous and non-famous people. Authors found that as age increases the performance in episodic memory decreased. The 60-85 year group showed the decline in episodic memory both in cross-sectional as well as longitudinal. However, for younger age group the prediction differed for episodic memory in cross-sectional as well as longitudinal study. The study had large number of participants. It also controlled variable such as education. The study doesn't describe the reason for decline in episodic memory in 60-85 years.

Almond and Morrison (2014) assessed the age related difference on episodic memory which was affected by stimulus characteristics as well as specifically age of acquisition (AoA). The study included 80 individuals in the age range of 24-70 years. The age group were divided into younger group with the mean age of 24.3 years and older group with the mean age of 70.7 years. The word list was taken from Morrison, Chappell & Ellis (1997) which was divided into "early" and "late" depending on mean age of acquisition of words. The mean age of acquisition for early word list was 37.4 months where as 76.6 months for late word list. Participants were asked to rate each word by spending an equal amount of time. After rating all 30 words, standard 5-figure digit span task was carried out to tap working memory and to avoid the recency effect. Further, a free recall task then followed. Once again younger participants were allotted 60 seconds while older participants were allotted 90 seconds. The authors found that the elderly individuals shown recall deficits on initial trails as well as

acquisition of words were slower in successive trails. This was attributed to consequence of deficit in both encoding and consolidation. Furthermore, elderly individuals were able to recall earlier acquired words better than later acquired words than younger individuals. The study had incorporated wider age interval (Example: 24-70 years) which in turn may fail to trace subtle changes that may occur in the age range.

c) Working Memory

Working memory is a multidimensional cognitive construct which encompasses age related changes in assortment of cognitive tasks including long-term memory, language, problem solving, and decision making. The working memory system is most likely to be affected by aging. Age-related differences had been reported in working memory (Salthouse, 1991; Van der Linden, Bredart & Beerten, 1994). Age-related differences are more vital in working memory tasks for the subjects in order to carry out processing for simultaneously storing information (Van der Linden, Bredart & Beerten, 1994). Majority of the working memory model presume to have two types of components (Baddeley, 1986; Engle, Tuholski, Laughlin & Conway, 1999) : a) storage components mainly consist of specific to the type of information (e.g., verbal and visuo-spatial) and b) processing or executive function components that can be used for selecting, manipulating, and coordinating information in the storage components. A plenty of studies have proven that verbal storage are less likely to be affected than spatial storage by aging (Jenkins, Myerson, Joerding & Hale, 2000) or storage capacity gets less affected than executive aspects of working memory.

Myerson, Emery, White and Hale (2003) studied the effects of age, domain, and processing demands on Memory Span. The study included 1,050 adult participants in

the age range of 20-89 years. The authors divided the 1,050 participants into 10 groups; i.e. 20-24, 25-29, 30-34, 35-44, 45- 54, 55-64, 65-69, 70-74, 80-84, 85-89 years. The memory span was assessed using Wechsler Memory Scale – Third Edition (WMS-III) which has sections like Digits Forward and Digits Backward. The participants were instructed to recall the digits in the order which was presented for forward and reverse order for backward. Initially the test begins with two digits for both forward and backward digits. Further, forward digit was gradually increased to 8 digits whereas for digit backward increased to 7 digits. The authors found no age related deficit in forward digit span versus backward digit span for either digital span or spatial span. This result is supported by another study by Gregoire and Van der Linden (1997) for the French WAIS-R normative sample. The study doesn't discuss for equal performance obtained in both backward digit span and forward digit span in the age range of 20- 89 years.

Elliott, Cherry, Brown, Smitherman, Jazwinski, Yu, and Volaufova (2011) studied age related differences in short-term and working memory performance among individuals in the age range of 45-90 years. The participants were divided into middle-aged (45–64 years), young-old (65–74 years), old-old (75–89 years) and oldest-old adults (90 years and over). To assess working memory, both forward digit and backward digit task were administered on participants. For forward digit task, the lists of digit were presented from 3 digits to 9 digits. Then, they were asked to recite the numerals in the same order of presentation. Similarly, for backward digit task the list of digits presented and was asked to recite in backward order of presentation. The lists of digit were presented from 2 digits to 8 digits. Authors found that drastic reduction in recall performance across output serial positions by the two oldest groups of adults compared to other group. Further, back ward digit performance was worse

than forward digit performance across age group. In addition as the size of the digits increases in both forward digit and backward digit task, the performance decreased as the age increases. The study did not consider certain other variables such as education and sensory issues.

Kempe, Kalicinski and Memmert (2015) assessed naturalistic memory performance in elderly individuals. The study involved 23 older (mean age; 70.28 ± 4.65 years) and 20 younger adults (mean age; 24.89 ± 3.16 years). The "Supermarket'' was being constructed within the laboratory. The memory tasks such as short-term and working memory (Digit Simple Span, Digit Complex Span, Grid Simple Span and Grid Complex Span) were being assessed. Authors found that older adults showed alterations than younger adults on memory performance. The study fails to include large number of participants as it is difficult to generalize the results.

d) Semantic Memory

Semantic memory refers to the storage of general knowledge about the world and knowledge of words as well as concepts. In general, elderly adults do not show deficit in semantic memory (Kamath, 2001).

Co-ordinate naming and Super-ordinate naming

Sunil Kumar (2009) aimed to standardize the test material between individuals with dementia and normal population. The study incorporated 90 normal individuals in the age range of 20- 60 years and above and 30 individuals with various types of Dementia in the age range of 55-81 years. Dementia Assessment Battery-Kannada was administered on participants that taps memory domain such as semantic memory (Co-ordinate naming and Super-ordinate naming). For Co-ordinate naming, the

participants were asked to generate two names for given activity. Example: Name two item used for writing. Further, the participants were asked to name the particular class or category for the given items for Super-ordinate naming. Example: Dog, cat, lion and monkey belongs to which group. Result revealed, for both co-ordinate naming and super ordinate naming insignificant difference was found in the age range of 20-60 years. However, significant difference was found for co-ordinate naming and super-ordinate naming between normal individuals and individuals with various type of dementia. The study did not consider certain variables such as education, socioeconomic status of the participants.

Kumar (2012) adapted the CLAP of Kannada version to Hindi language. The study included 60 native speaker of Hindi in the age range of 40 to 80 years. The participants were divided into 5 groups; i.e., Group I (40-50 years), Group II (51-60 years), Group III (61-70 years), Group IV (71-80 years) and Group V (above 80 years). In memory domain, Co-ordinate naming and Super-ordinate naming were being assessed. The authors found that across age groups similar performance was obtained for Co-ordinate naming. For Super-ordinate naming, the performance slightly differed across age groups. However, it was not that significant difference observed between the groups. The reason for similar performance in Co-ordinate naming and Super-ordinate naming by older groups was that semantic memory remains stable as it is related to the experience of person. The study did not taken into account "education" of participants as one of the variable.

Word Naming Fluency

Tombaugh, Kozak, and Rees (1999) examined the effects of aging on acquisition, retention of visual as well as verbal information. The study included 1,300 individuals

in the age range of 16-95 years. The participants instructed to generate words in 1 minute for the letters F, A, and S (phonemic fluency) and animal names in 1 minute (Semantic fluency). The authors found phonemic fluency decreased with increase in age with the least amount of change occurring from ages 16 to 59 years. This study provide norms for only the following phonemes F, A, and S or the category of animals as there were greater variation occurred among the number of names generated to different letters of the alphabet. The norms are only applicable only if the person is fluent in English and this could be one of the demerits of this study. Also, studies by Crossley, D'arcy & Rawson (1997); Auriacombe, Fabrigoule, Lafont, Amieva, Gadda & Dartigues (2001) revealed that in categorical verbal fluency, older individuals performed worse than younger individuals.

Lakshmi (2010) aimed to adapt the Kannada Version of CLAP to Malayalam language. The study had considered 60 Malayalam speaking participants in the age range of 65-80 years. The participants were divided into Group I (65-70 years), Group II (70-75 years) and Groups III (75-80 years). In memory domain, Semantic Memory was a sub test. Under that word naming fluency was assessed by asking to recall at least five words for specified syllables. Authors found that significant difference for word naming fluency task across age groups. Further, Duncan's post hoc analysis showed significant difference between all three groups; i.e., 65-70 years showed significant difference with 70-75 years and 75-80 years, respectively. However no gender effect was observed. Also no interaction effect between age and gender was reported. The study failed to justify the reason for significant difference for word naming fluency task across age groups.

Kumar (2012) adapted the CLAP of Kannada version to Hindi language. The study enclosed 60 individual with Hindi speaker in the age range of 40-80 years. Word naming fluency was assessed to tap semantic memory. The participants were asked to recall minimum of 5 words for given syllables. The author found that word naming fluency decreased with increase in age. The study failed to explain reason for decreased performance in word naming fluency as the function of age.

Kim, Lee, Oh, Hong, Lee, Son, and Kim (2013) studied the effect of age, gender, and education on lexical verbal fluency in an educationally-diverse, elderly Korean population. The study included 1676 cognitively normal subjects in the age range of 60-84 years. The lexical verbal fluency test (LVFT) was administered in which participants were asked to generate as many words as possible with the specified letter within 60 seconds. Results revealed that age and education associated with LVFT performance but gender did not. Further, three-way ANOVA was carried out to verify interaction among age, gender and education on LVFT. It revealed main effects of age and education level were significant. However, gender did not. The performance in LVFT tends to decrease with increase in age. Furthermore, the post hoc contrast revealed elder individuals performed poorer than younger individuals. And highly educated individuals tend to perform better than low educated individuals attributing to significant differences between sequential pair of age group and sequential pair of educational level. The study had employed only a single letter for assessing lexical fluency. Even though the lexical fluency test using single letter were widely used as one of the neuropsychological test batteries (Mathuranath, Nestor, Berrios, Rakowicz & Hodges, 2000), most of the earlier studies on the association between demographic characteristics and lexical fluency were assessed using Controlled Oral Word

Association Test employing letter triads (Borkowski, Benton & Spreen1967). The study fails to justify reason for poor performance on LVFT task as age increases.

Generative Naming

Foldi, Estabrooks, Redfield & Nickel (2003) studied the impact of aging on perseverative behavior. In this study, 73 healthy individuals in the age range of 18-88 years were participated. Participants of the study were divided into four age groups (18–39, 40–59, 60–74 and 75–88). The Cognitive Linguistic Quick Test (CLQT) was used to assess the following domains such as: Design Generation, Generative Naming (animals, and words starting with the letter /m/), and correlated with data from Symbol Trails, Symbol Cancellation, Story Retelling, and Mazes tasks. The authors found that perseveration rate was insignificantly correlated across the three fluency tasks. However, age was significantly correlated with perseveration rate only on the Design Generation task, but not for animal naming or starts with /m/ Words. Similarly, /m/ Word generation (the animal naming) had no effect with age on perseveration rates in this study. Furthermore, two older groups generated lesser animal names than younger group. In each group, the numbers of subjects were unequal and very less number of subjects participated in the study.

Lakshmi (2010) assessed cognitive linguistic abilities in normal elderly individuals. The study enclosed 60 individuals with Malayalam speaker in the age range of 65-80 years. Semantic memory was assessed through Generative naming. The participants were presented with description and asked to name for given description. Author found that no significant difference across age groups on generative naming. Irrespective of age and gender, similar performance was seen on generative naming task. This was attributed to the semantic memory that involves in everyday

experience. Further, all types of memory doesn't decline. However, decline depends of memory type as well as life of the circumstance of an individual.

Vandana, Chengappa & Jahan (2013) examined the cognitive linguistic skill in Kannada speaking monolingual and bilingual (Kannada-English) individuals. A total of 180 normal healthy individuals in the age range of 20- 80 years had chosen for the study. They have been divided into three groups; i.e., 20-40, 40-60 and 60-80 years. Each group had 60 individual each. Out of which, 30 were Kannada speaking monolingual and 30 were Kannada-English speaking bilinguals. The Cognitive-Linguistic Quick Test in Kannada (CLQT-K) was administered which has following subsections such as attention, memory, executive functions, language and visuo-spatial skills. Authors found that 60-80 years individuals performed significantly different from 20 to 40 years adults and 40 to 60 years adults in tasks like personal facts and confrontation naming. Further, the performance of monolinguals in all the tasks was poorer than bilinguals in the age range of 60-80 years. In addition, younger participants performed significantly better than elderly monolinguals in both linguistic and non-linguistic tasks. However, study failed to control certain variables such as education level and socioeconomic status of the participants.

Sentence repetition task and carrying out command

Rajasudhakar (2005) explored the effect of age, gender and bilingualism on cognitive linguistic performances in young and older individuals. This study was carried out on normal Kannada speaking monolinguals (Kannada) and bilinguals (Kannada-English) in both males and females in the age range of 20 to 30 years and 70 to 80 years. The result revealed that younger bilingual performance was more statistically significant on all domain of cognitive linguistic task. Further, in both monolingual and bilingual,

younger adults performed faster in all the timed tasks on cognitive linguistic assessment protocol than the elderly individuals. Also, author found poor cognitive linguistic performance in elderly monolingual individuals compared to elderly bilingual individuals.

Shyamala and Ravi Kumar (2008) aimed to standardize the Kannada version of Western Aphasia Battery test as well as to present the normative data for normal individuals and patients with aphasia. The study included 22 normal (16 males and 6 females) and 90 aphasics in the age range of 30 –70 years. The Kannada version of Western Aphasia Battery was administered on participants which had subsections such as Spontaneous speech, repetition, comprehension, and naming. Authors found that no significant difference in episodic and semantic memory across young adults (20-40 years), adults (40-60 years) and geriatric (60 and above). However, poor performance was found on working memory in geriatric group. The study failed to include equal number of participants in control and experimental groups, and also the generalizing the results to the population is difficult due to smaller sample size.

Lakshmi (2010) investigated cognitive linguistic skills in older individuals in the age range of 65-80 years. Totally 60 Malayalam speakers were took part in this study. To tap semantic memory tasks like sentence repetition and carrying out command were assessed. For semantic memory, sentence repetition task was assessed; participants were presented with sentences and asked to repeat the sentence after examiner reads out. For semantic memory, carrying out command was assessed where clinician asked to follow certain commands. Author found that across age groups, no significant difference seen for both sentence repetition task and carrying out command task.

Kumar (2012) assessed cognitive linguistic abilities in Hindi speaker individuals in the age range of 40-80 years. In memory domain, sentence repetition task and carrying out command were assessed. For sentence repetition task, participants were asked to repeat the sentence after examiner reads out. For carrying out command, asked to follow the command. Author found that no significant difference in both sentence repetition task and carrying out command across age groups.

The literature review revealed that there is a considerable age related differences among healthy elderly individuals in different types of memories such as episodic, working and semantic memory. Further, majority of these studies have been conducted in the western population and a very few studies are available in the Indian context in general and Kannada language in particular. A study by Kamath (2001) documents the changes in the performance on cognitive linguistic task in Kannada. The study included 36 healthy individuals in the age range of 40-70 years. Cognitive Linguistic Assessment Protocol (CLAP) was developed and used to tap cognitive linguistic abilities such as attention, perception, discrimination, memory, reasoning, problem solving and organization. The author found that small differences in the performance on subtest such as attention, perception, discrimination, memory, reasoning, problem solving and organization across age range as well as gender. Though these differences were statistically not significant which were determined by t-test. The author concluded that, though the performance on each subtest showed statistically not significant, the relationship among cognition and language showed significantly more correlated for time constrained task. This study failed to include old-old geriatric individuals and did not consider participant's education level and socioeconomic status. Furthermore, only 6 males and 6 females were considered between 60 to 70 years as participants in the above study.

Inapplicability of Western Assessment Tools for Indian Contexts

To summarize, the western assessment batteries which have been standardized is not relevant to the Indian context owing to multilingual in nature. The western assessment batteries are predisposed to linguistic and ethno cultural issues when it is administered on Indian population. There is a dearth of empirical data in elderly individuals on cognitive linguistic abilities in Indian context. Though, available few tests for assessing cognitive functions such as memory, attention, executive functions and so on in Indian context, did not consider certain variables such as socioeconomic status and educational background of participants. Indeed, these variables can also influence the performance of individuals on various cognitive and linguistic tasks. Hence, the need arose. Hence, with the background information summarized above the present study aimed to investigate episodic, working and semantic memory abilities in 101 neuro-typical elderly individuals in the age range of 60-70 years.

CHAPTER III

METHOD

Participants

The present study incorporated totally 101 neruo-typical elderly individuals in the age range of 60-69.11 years. They were divided into two groups i.e, Group I and Group II. Group I consisted of 50 neuro-typical elderly individuals in the age range of 60-64.11 years where as Group II consisted of 51 neuro-typical elderly individuals in the age range of 65- 69.11 years. Table 3.1 depicts the participants information.

Table 3.1
Details of the participants

Groups	**Age -range**	**No. of Males**	**No. of Females**	**Total**
Group I	60-64.11 years	25	25	50
Group II	65- 69.11 years	27	24	51
			Total	101

Inclusion criteria of the participants

The following criteria were considered in the selection of participants;

1) The participants should be free from any history of speech, language, hearing and communication problems.
2) The participants should be able to speak, read and write in Kannada. And they should have at least tenth standard of education/schooling.
3) The participants should be free from any history of neurological and/or psychological problem.
4) The participants should be free from alcohol/drug abuse for the past 10 to 15 years.
5) The participants must be physically fit at the time of testing.

6) The participants should pass in Mini Mental State Examination (MMSE) by scoring greater than or equal to 25 points (as per Flanaga & Jackson, 1997) (See Appendix I).
7) The participants should have normal or corrected vision.
8) The participants belonging to middle and higher socioeconomic status will be selected in the study, which will be ensured using NIMH Socio-economic status scale (Venkatesan, 2011) (See Appendix II).

Test Material

The Cognitive Linguistic Assessment Protocol in Kannada (CLAP-K) developed by Kamath (2001) was used to assess cognitive linguistic abilities in neuro-typical elderly individuals. It consists of seven subsection such as Attention, Perception, Discrimination, Memory, Reasoning, Problem solving and Organization. Among these subsections, focus was only given to Memory domain such as the episodic, working and semantic memory. Table 3.2, shows the subsections under Memory domains and its scoring.

Table 3.2
Sub tests under m*emory domain and its scoring*

Memory domain	Test item	Maximum score
Episodic memory	Orientation and recent memory questions	10
Working memory	• Digit forward	5
	• Digit backward	5
Semantic memory	• Co-ordinate naming	5
	• Super-ordinate naming	5
	• Word naming fluency	5*
	• Generative naming	5
	• Sentence repetition	10
	• Carry out command	10

*Indicates 'timed task' where the experimenter note down the responses of participants for a minute. The total score for memory domain is 60

Episodic Memory: It is assessed by asking question related to the orientation of self with respect to place, self and time as well as few question related to general knowledge. It comprised of totally 10 questions.

Scoring: 1 for each correct response.

Working Memory: It is assessed through digit forward and backward repetition task. The participants were asked to repeat numbers in same order of the presentation.

Scoring: 1 for every correctly repeated sequence. No score will be given even all numbers repeated in random order.

Semantic Memory: It taps the language knowledge such as:

a) Co-ordinate naming: The individuals were given a noun class and asked to name at least five objects within the given class.

Scoring: 1 for each correct response

b) ***Super-ordinate naming:*** A list of belonging or items to a particular class were presented to the individuals in order to identify the given class/category.

Scoring: 1 for each correct response.

c) ***Word naming fluency:*** It is carried out to tap recall abilities. Individuals were asked to generate five words that begin with the specified letter or phoneme. It's a time constrained task. Number of words/nouns produced will be noted for 60 seconds.

Scoring: 1 for five words on every phoneme. No points were given if unable to name five or less than five words.

d) ***Generative naming:*** Individuals were asked to name the target word for given description.

Scoring: 1 for every correct word for a given description.

e) ***Sentence repetition:*** A phrase/sentence were read aloud and individuals were asked to recite the same immediately.

Scoring: For simple phrase or sentence, score of 1 will be given and as the complexity of phrase or sentence increases score of 2, 3 and 4 were given, respectively.

f) ***Carrying out commands:*** Two objects such as book and pen will be placed in front of the subject. Individuals were asked to follow the commands uttered by the examiner. Complexity of task increases gradually from simple to complex.

Scoring: Score 1 will be given for following simple commands and on increase in complexity of command, score of 2, 3 and 4 were given accordingly.

Procedure

Participants were selected from the residential area in and around Mysore city. The objectives of the study explained to the participants and written consent was obtained (See Appendix III). The Memory domain of Cognitive Linguistic Assessment Protocol in Kannada (CLAP-K) by Kamath (2001) (See Appendix IV) was administered on individuals in a noise free environment/room. Instructions specific to the task was provided in Kannada. The responses were audio recorded using a digital audio tape recorder. Break of 5 to 10 minutes was provided if the participant gets tired/ distracted or else the data collection were done in single sitting. The administration of the test was around 15 to 20 minutes.

Scoring

The scoring for each task was carried out as per the scoring procedure by listening to the recorded sample. No scoring was given if the response is incorrect/wrong. The total score obtained for Memory domain and also percentage of the total score was calculated.

Statistical Analysis

The scores of Memory domain were calculated separately for Group I and Group II. Further, group comparison, comparison between gender and trend of decline (if any) from 60- 64.11 years (group I) to 65-70 years (group II) were done by using statistical test. Shapiro-Wilk test was done for both Group I and Group II separately to check whether the data falls within normality curve or not. For descriptive statistics, Mean, Median and Standard deviation were calculated for each subtest of memory domains as well as percentage of the total score. As the data was not normally distributed, non-parametric test was carried out for further

statistical analysis. Mann-Whitney U test was done for comparing between Groups I and Group II as well as comparing between genders. Within Group comparison was carried out using Friedman's test separately for group I and group II. Further, Wilcoxon signed rank test was administered to see significant difference across percentage of episodic, working and semantic memory scores within each group.

CHAPTER IV

RESULTS

The present study aimed to investigate episodic, working and semantic memory abilities in neuro-typical elderly individuals in the age range of 60-70 years. Two group of participants participated in the study.ie, Group I (60-64.11years) and Group II (65- 69.11 Years). The Cognitive Linguistic Assessment Protocol in Kannada (CLAP-K) developed by Kamath (2001) administered on 101 in individuals (52 males, 49 females). Among the subsections of the test (CLAP-K), focus was given on Memory domain such as the episodic, working and semantic memory. Data obtained from different tasks of Memory were computed and analyzed. The results of the present study were discussed under the following subheadings;

4.1) Between group comparisons;

a) Overall scores

b) Gender difference

c) Group difference

d) Word Naming Fluency (timed task)

4.2) Within group comparison;

a) Percent scores on memory domain

b) Across task difference in males in Group I

c) Across task difference in females in Group I

d) Across task difference in males in Group II

e) Across task difference in females in Group II

4.3) Test-retest reliability

4.1) Between Group Comparisons

a) Overall scores

Table 4.1
Mean, standard deviation (SD) and Median scores of memory domain (Episodic, Working & Semantic memory)

			Males			Females		
Subsections		**Groups**	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Episodic memory	**OR**	I	9.52	0.58	10.00	9.56	0.76	10.00
		II	9.46	0.76	10.00	9.08	0.75	9.00
Working memory	**DF**	I	3.64	1.03	4.00	3.72	0.89	4.00
		II	3.42	1.02	3.00	3.12	1.16	3.00
	DB	I	1.60	0.76	1.00	1.28	0.79	1.00
		II	1.35	0.97	1.00	1.24	0.83	1.00
Semantic memory	**CN**	I	3.32	1.37	4.00	3.24	1.09	3.00
		II	3.19	1.26	3.50	3.08	1.25	3.00
	SN	I	4.28	0.67	4.00	4.08	0.75	4.00
		II	4.00	0.69	4.00	4.00	0.64	4.00
	WNF	I	4.36	0.90	5.00	4.36	0.90	5.00
		II	4.00	1.26	4.50	3.96	1.54	5.00
	GN	I	4.92	0.27	5.00	4.84	0.37	5.00
		II	4.88	0.32	5.00	4.84	0.37	5.00
	SR	I	10.00	0.00	10.00	10.00	0.00	10.00
		II	10.00	0.00	10.00	10.00	0.00	10.00
	CC	I	10.00	0.00	10.00	10.00	0.00	10.00
		II	10.00	0.00	10.00	10.00	0.00	10.00

(OR= Orientation and Recent memory questions; DF= Digit Forward; DB= Digit Backward; CN= Co-ordinate Naming; SN= Super-ordinate Naming; WNF= Word Naming Fluency; GN= Generative Naming; SR= Sentence Repetition; CC= Carry out Command)

Episodic Memory: Orientation and Recent memory questions (OR)

The mean, standard deviation and median of orientation and recent memory questions (OR) scores of both group I and group II are shown in the table 4.1. The mean and median OR scores for males were 9.52 and 10, where as for females it was 9.56 and 10 respectively in group I. And the mean and median OR scores of group II were 9.46

and 10 for males; 9.08 and 9 for females, respectively. That is, the mean OR scores were higher for both males and females in group I compared to group II.

Working Memory: Digit forward (DF)

In group I, 3.64 and 4 were the mean and median of digit forward scores for males and for females were 3.72 and 4, respectively. Further, in group II the mean and median of digit forward scores were 3.42 and 3 for males; 3.12 and 3 for females, respectively. That is, the mean score of digit forward were higher in group I compared to group II. Females performed relatively better than males on digit forward in group I. On the other hand, males outperformed females on digit forward in group II.

Working Memory: Digit backward (DB)

The mean and median score of digit backward in group I were 1.60 and 1 for males; 1.28 and 1 for females, respectively. The mean and median scores on digit backwards score in group II were 1.35 and 1 for males; 1.24 and 1 for females, respectively. Both males and females of group I obtained higher mean score for digit backward than group II.

Semantic Memory: Co-ordinate naming (CN)

Males and females of group I obtained mean and median score of co-ordinate naming as 3.32 and 4; 3.24 and 3, respectively. Mean and median of co-ordinate naming of males and females in Group II were 3.19 and 3.50; 3.08 and 3, respectively. That is, males and females of group I had relatively higher mean value for co-ordinate naming when compared to group II.

Semantic Memory: Super-ordinate naming (SN)

The mean and median on super-ordinate naming scores for males and females of group I were 4.28 and 4; 4.08 and 4, respectively. The mean and median scores of super-ordinate naming of group II were similar for both males and females i.e., (4 and 4). That is, mean score of super-ordinate naming of group I performed relatively better than group II.

Semantic Memory: Word naming fluency (WNF)

Score of mean and median for word naming fluency in males and females of group I were 4.36 and 5; 4.36 and 5, respectively. The mean and median score of word naming fluency in males and females of group II were 4 and 4.5; 3.96 and 5, respectively. That is, the mean value for word naming fluency of males and females of group I had higher value than group II.

Semantic Memory: Generative naming (GN)

The mean and median score on generative naming in males and females of group I were 4.92 and 5; 4.84 and 5, respectively. On the other hand, the mean and median score on generative naming in males and females of group II were 4.88 and 5; 4.84 and 5, respectively. That is, both males and females of group I and group II on generative naming performed similarly.

Semantic Memory: Sentence repetition (SR) and Carry out command (CC)

A ceiling score of 10 (Maximum score) is reached in two tasks like SR and CC by both the groups (I and II). That is, no difference in SR and CC's scores between genders in both the groups.

Total scores on Episodic memory, Working memory and Semantic memory

Table 4.2
Mean, Standard deviation (SD) and Median scores of EM, WM, SM.

Groups		Males			Female			Combined Total		
		Mean	**SD**	**Median**	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Group I	**EM**	9.52	0.58	10.00	9.52	0.77	10.00	9.52	0.67	10.00
	WM	5.24	1.45	5.00	5.00	1.44	5.00	5.12	1.43	5.00
	SM	36.88	2.02	37.00	36.52	1.73	37.00	36.70	1.87	37.00
Group II	**EM**	9.48	0.75	10.00	9.04	0.75	9.00	9.27	0.77	9.00
	WM	4.81	1.73	5.00	4.29	1.70	4.00	4.57	1.72	4.00
	SM	36.11	1.96	37.00	35.83	2.23	37.00	35.98	2.08	37.00
Combined Group Total	**EM**	9.50	0.67	10.00	9.29	0.79	9.00	9.40	0.73	10.00
	WM	5.02	1.60	5.00	4.65	1.60	5.00	4.84	1.60	5.00
	SM	36.48	2.01	37.00	36.18	2.00	37.00	36.34	2.00	37.00

EM=Episodic Memory; WM=Working Memory; SM=Semantic Memory

The mean and median scores of episodic memory were similar for males and females in group I i.e., (10 and 10). So, even the performance of males and females on EM in group II was also similar. One must note that both group I and group II performed similarly on EM. Working memory section has two sub tasks and semantic memory subsection has six sub tasks in the present study. The total scores were calculated by summing the sub tasks scores to get working and semantic memory scores which is as shown in the table 4.2. The mean and median score of WM in males and females of group I were similar (5). For group II, mean and median score of WM of males and females were 5 and 5; 4 and 4, respectively. That is, mean scores of WM were relatively poorer in group II compared to group I. The mean and median scores of

males and females of semantic memory in group I were 36.88 and 37; 36.52 and 37, respectively. The mean and median scores of SM of males and females in group II were 36.11 and 37; 35.83 and 37, respectively. This indicates that mean scores of SM of group I were higher than group II in both males and females.

To summarize from table 4.2, it is observed that total scores on episodic, working and semantic memory in males and females of both group preformed similarly.

b) Gender difference

Table 4.3, shows results of Mann-Whitney U test for gender difference in group I and group II on Episodic memory, Working memory and Semantic memory tasks.

Table 4.3
Results of Mann-Whitney U test for group I and group II for gender difference

Memory domains	Sub tests	Group I		Group II	
		/z/	Sig.	/z/	Sig.
Episodic Memory	**OR**	0.68	0.49	1.97	0.04*
Working Memory	**DF**	0.13	0.89	0.84	0.39
	DB	1.37	0.17	0.50	0.61
Semantic Memory	**CN**	0.31	0.75	0.3	0.74
	SN	0.93	0.34	0.00	1.00
	WNF	0.00	1.00	0.26	0.79
	GN	0.86	0.38	0.45	0.64
	CR	0.00	1.00	0.00	1.00
	CC	0.00	1.00	0.00	1.00

(indicates significant at 0.05 level)*

(OR= Orientation and Recent memory questions; DF= Digit Forward; DB= Digit Backward; CN= Co-ordinate Naming; SN= Super-ordinate Naming; WNF= Word Naming Fluency; GN= Generative Naming; SR= Sentence Repetition; CC= Carry out Command).

Results of Mann-Whitney U test revealed that there is no significant difference between males and females in group I across memory tasks. Where as in group II, gender difference was found only for Episodic memory (/z/= 1.97, $p<0.05$) and not on other memory tasks (WM and SM).

c) Group difference

Table 4.4
Results of Mann-Whitney U test for group difference on memory tasks.

Subsections				
Sl.no			**/z/**	**Sig.**
1	**Episodic Memory**	**OR**	1.87	0.06
2	**Working Memory**	**DF**	1.89	0.06
3		**DB**	1.12	0.26
4	**Semantic Memory**	**CN**	0.56	0.57
5		**SN**	1.34	0.18
6		**WNF**	1.06	0.28
7		**GN**	0.25	0.79
8		**CR**	0.00	1.00
9		**CC**	0.00	1.00

As the data failed the assumption of normality, non-parametric test was done in the study. Hence, Mann-Whitney U test was carried out in order to check for significant difference between Group I and Group II on episodic, working and semantic memory tasks. From table 4.4, the Mann-Whitney U test revealed no significant difference between group I and group II irrespective of memory tasks.

d) Word Naming Fluency – Timed task comparison

Out of six tasks under Semantic memory, word naming fluency (WNF) task is the only timed task. The time taken to complete the task is measured. Table 4.5, shows

the mean, median and standard deviation (SD) scores in seconds on Word Naming Fluency across two groups and genders.

Table 4.5
Mean, Standard deviation (SD) and Median score (in seconds) on Word Naming Fluency across two groups and genders.

	Groups	**Males**			**Females**			**Total**		
		Mean (sec)	**S.D**	**Median**	**Mean (Sec)**	**S.D**	**Median**	**Mean (Sec)**	**S.D**	**Median**
/p/	I	16.12	10.14	16.00	19.52	12.91	17.00	17.82	11.61	16.00
	II	17.11	11.94	15.00	17.08	11.41	17.00	17.10	11.58	16.00
/a/	I	19.44	15.22	17.00	16.24	14.46	16.00	17.84	14.78	16.00
	II	13.19	15.14	10.00	14.88	11.56	15.00	13.98	13.47	12.00
/s/	I	18.56	8.61	18.00	19.12	11.38	16.00	18.84	9.99	17.50
	II	16.04	8.57	16.00	19.00	9.76	19.00	17.43	9.18	18.00
/i/	I	15.56	10.02	16.00	25.08	14.05	27.50	20.22	12.96	19.00
	II	18.04	15.67	17.00	16.58	12.05	17.50	17.35	13.97	17.00
/t̲/	I	17.12	9.65	15.00	21.64	12.98	17.00	19.38	11.54	16.00
	II	16.44	9.32	16.00	14.63	12.19	11.50	15.59	10.69	14.00

Totally there were 6 phonemes included in word naming fluency task. The mean and median performance time (in seconds) is depicted for each of the phoneme in table 4.5. The mean duration of 6 phonemes were averaged and compared between two groups and gender which is shown in table 4.8.

Gender difference in WNF (Timed task)

Mann - Whitney U test was used to check the gender difference for word naming fluency. Results of Mann-Whitney U test revealed no significant difference was observed between males and females in Group I across phonemes in word naming

task except for the phoneme /i/. Only /i/ has showed significant difference between genders (/z/= 2.56; p<0.001). On other hand, in Group II results revealed no significant difference observed between males and females across phonemes in word naming fluency task.

Table 4.6
Results of Mann – Whitney U test for gender comparison in group I and group II on Word Naming Fluency

	Genders			
Phonemes	**Group I**		**Group II**	
	/z/	**Sig.**	**/z/**	**Sig.**
/p/	0.50	0.61	0.11	0.91
/a/	0.79	0.42	1.02	0.30
/s/	0.04	0.96	1.11	0.26
/i/	2.56	0.01*	0.27	0.78
/t̲/	1.06	0.28	1.07	0.28

(* indicates significant at 0.05 level)

Group difference in WNF (Timed task)

From table 4.7, Mann-Whitney U test revealed no significant difference between group I and group II on word naming fluency.

Table 4.7
Results of Mann-Whitney U test for group comparison on WNF

Phonemes	**Groups**	
	/z/	**Sig.**
/p/	0.18	0.85
/a/	1.31	0.18
/s/	0.45	0.65
/i/	1.02	0.30
/t̲/	1.65	0.09

Table 4.8

Average Mean value (in seconds) for Word Naming Fluency between groups and genders

Groups	Males	Females	Total
	Mean (in seconds)	**Mean (in seconds)**	
I	17.36	20.32	37.68
II	16.16	16.43	32.59

Males and females of group I took the average duration of 17.36 and 20.32 seconds, respectively for word naming fluency. Males and females of group II took the average duration of 16.16 and 16.43 seconds, respectively. That is, both males and females of group II performed faster in word naming fluency task than males and females of group I. Table 4.8, revealed that group II performed the word naming fluency task with the duration of 32.59 seconds. On the other hand, group I took the duration of 37.68 seconds to complete the task. This indicates that group II performed faster to complete word naming fluency task than group I. To summarize, in group I of males performed faster on word naming fluency task than females. However, both males and females in group II performed similarly on word naming fluency task. In general, group I took longer duration to complete word naming fluency task than group II.

4.2) Within group comparison

a) Percent scores on memory domains

The raw scores of episodic, working and semantic memory do not have equal scoring weightage. i.e., episodic and working memory has maximum score of 10. Whereas, semantic memory has a maximum score of 40. Hence, raw score of the same was converted into percentage for comparing across the memory tasks. Table 4.9, shows the Mean and SD of percent scores of different memory tasks between two groups and genders.

Table 4.9

Mean and standard deviation (SD) scores of percent scores of EM, WM, and SM across groups and genders.

Groups						**Combined Total**	
		Males		**Females**			
		Mean (in %)	**SD**	**Mean (in %)**	**SD**	**Mean (in %)**	**SD**
Group I	**EM**	95.20	5.85	95.20	7.70	95.20	6.77
	WM	52.40	14.51	50.00	14.43	51.20	14.37
	SM	92.20	5.06	91.30	4.33	91.75	4.69
	Total	86.06	4.78	85.06	4.62	85.56	4.68
Group II	**EM**	94.81	7.52	90.41	7.50	92.74	7.76
	WM	48.14	17.32	42.91	17.06	45.68	17.23
	SM	90.27	4.91	89.58	5.59	89.95	5.20
	Total	84.00	5.57	81.70	6.10	82.93	5.88

From table 4.9, the mean percent scores of episodic, working and semantic memory for males in group I were 95%, 52% and 92%. That is, participants in group I performed best in EM followed by SM and working memory was difficult for them, as they scored just above 50% (EM > SM > WM).

b) Across tasks difference in males in group I

Table 4.10 shows the results of Friedman's test for task difference in males of group I. From table 4.10, Friedman's test results revealed that there was a significant difference between memory domains in males of group I, {$\chi 2$ (2, 25) = 39.918, p< 0.001}.

Table 4.10
Results of Friedman's test for task difference in males of group I

	N	Chi-Square	df	Asymp. Sig.
Males	25	39.918	2	0.000*

(*p< 0.001)

Table 4.11
Results of Wilcoxon Signed-rank test for pair wise comparison between different memory domain in males of Group I.

	PercentWM - PercentSM	PercntEM - PercentSM	PercentEM - PercentWM
z	-4.376[c]	-1.636[d]	-4.417[d]
Asymp. Sig. (2-tailed)	0.000*	0.102	0.000*

(*p< 0.001)

From table 4.11, results of Wilcoxon signed-rank test of males in group I revealed that there was a significant difference between working and semantic memory scores (/z/ = 4.376, p < 0.001); as well as episodic and working memory scores (/z/= 4.417, p< 0.001).

c) Across tasks difference in females in group I

From table 4.9, the mean percent scores of episodic, working and semantic memory for group I in females were 95%, 50% and 91%. That is, similar trend was observed in females of group I (EM > SM > WM).

As below mentioned table 4.12, Friedman's test revealed that there was a significant difference on episodic memory, semantic memory and working memory in females of group I, {χ2 (2, 25) = 42.701, p< 0.001}.

Table 4.12
Results of Friedman's test for task difference in females of group I

	N	Chi-Square	df	Asymp. Sig.
Females	25	42.701	2	0.000*

(*p< 0.001)

Table 4.13
Results of Wilcoxon Signed-rank test for pair-wise comparison between memory domains in females of Group I

	PercentWM - PercentSM	PercntEM - PercentSM	PercentEM - PercentWM
z	-4.376[c]	-2.741[d]	-4.396[d]
Asymp. Sig. (2-tailed)	0.000*	0.006	0.000*

(*p< 0.001)

As above mentioned table 4.13, results of Wilcoxon signed-rank test for females in group I revealed that there was a significant difference between working and semantic memory scores (/z/ = 4.376, p < 0.001) as well as percentage of episodic and working memory scores (/z/ = 3.396, p<0.001).

d) Across task difference in Males in group II

From table 4.9, the mean percent scores of episodic, working and semantic memory for group II in males were 95%, 48% and 90%. That is, participants in group II performed better in EM than other memory (EM > SM > WM). Participants in group II failed to reach even score of 50% on working memory.

Table 4.14
Results of Friedman's test for task difference in males of group II

	N	Chi-Square	df	Asymp. Sig.
Males	27	45.509	2	0.000*

(*p< 0.001)

Above mentioned table 4.14, Friedman's test result revealed that there was a significant difference was found between memory domains in males, $\chi 2$ (2, 27) = 45.509, p< 0.001 and in females, $\chi 2$ (2, 24) = 36.400, p< 0.00, (table 4.16) respectively.

Table 4.15
Results of Wilcoxon Signed-rank test for pair-wise comparison between different Memory domains in males of Group II

	PercentWM - PercentSM	PercntEM - PercentSM	PercentEM - PercentWM
z	-4.543[c]	-3.082[d]	-4.560[d]
Asymp. Sig. (2-tailed)	0.000*	0.002*	0.000*

(*p< 0.001)

From table 4.15, results of Wilcoxon signed-rank test of males in group II revealed there was significant difference across tasks. i.e., scores on Working versus Semantic memory (/z/ = 4.543, p < 0.001); scores on Episodic versus Semantic memory (/z/= 3.082, p < 0.001); Scores on Episodic versus Working memory (/z/= 4.560, p < 0.001), respectively.

e) Across task difference in Females in group II

From table 4.9, the mean percent scores of episodic, working and semantic memory for group II in females were 90%, 43% and 90%. That is, participants in group II performed better in EM followed semantic memory and then by working memory. Participants in group II failed to reach even score of 50% on working memory (EM > SM > WM).

Table 4.16
Results of Friedman's test for task difference in group II of females

	N	Chi-Square	df	Asymp. Sig.
Females	24	36.400	2	0.000*

(*p< 0.001)

From table 4.16, results of Friedman's test showed significant difference between memory domains in males $\chi 2$ (2, 27) = 45.509, p< 0.001 and in females, $\chi 2$ (2, 24) = 36.400, p< 0.001 of group II, respectively.

Table 4.17
Results of Wilcoxon Signed-rank test for pair-wise comparison between different memory domain females of Group II

	PercentWM - PercentSM	PercntEM - PercentSM	PercentEM - PercentWM
z	-4.287[c]	-0.566[d]	-4.319[d]
Asymp. Sig. (2-tailed)	0.000*	0.571	0.000*

(*p< 0.001)

As above mention table 4.17, results of Wilcoxon signed-rank test revealed that significant different between scores in Working and Semantic memory (/z/=4.287, p < 0.001) as well as scores on Episodic and Working memory (/z/ = 4.319, p < 0.001), respectively and not between episodic and semantic memory.

4.3) Test-retest reliability

Test- retest reliability was done on 14% of the total population. This was done by administering the test on 14 participants within a gap of 20 days. The scores on first and second time were compared. The cronba co-efficient was ranging from 0.6 to 0.93 across the tasks. The overall test- retest reliability was 0.9 for the total score.

CHAPTER V

DISCUSSION

The purpose of the current study is to examine the effect of age on episodic, working and semantic memory in neuro-typical elderly individuals in the age range of 60-70 years. Further, group comparison and comparison between genders were also investigated.

The results of the present revealed several points of interest;

First, no significant difference observed between group I and group II on three different memory domains

The result of the current study revealed group I (60-64.11 years) performed relatively better than group II (65-69.11 years) across memory tasks (episodic, working and semantic memory). However, the difference between group I and group II was not significant. That is, across memory tasks a small decline was observed. It is speculated that, tasks that are enclosed in the episodic, working and semantic memory showed substantial losses suggesting the memory system for these tasks may be less vulnerable to age related changes in the elderly individuals (65-70years). Therefore, two groups performed almost similar on these memory tasks. This result is congruence with the previous studies of Kamath (2001) who reported no significant difference between age groups across memory tasks.

Second, no significant difference noticed for males and females on three different memory domain in group I and group II

Males of both groups (I and II) performed better than females on different memory tasks like episodic, working and semantic memory tasks. Suggesting that females

showed relatively faster and more decline when compared to males. This can be attributed to the difference in the education level (or) work exposure between males and females. The current study incorporated individuals having minimum education of tenth standard. On observation, male participants in the present study had higher education level when compared to females in both groups. Results of Mann-Whitney U test for gender comparison revealed no gender difference for Episodic, Working and Semantic memory in group I and gender difference noticed only for episodic memory and not for working and semantic memory in group II (Table 4.3). That is, out of nine memory sub tasks, only one task (orientation and recent memory) shown males performed significantly higher than females. Rest of the eight tasks did not find any gender effect. Hence, the results of present study are not in agreement with the study of Kamath (2001) who reported that females performed better than males on different memory tasks.

Third, participants of group II performed faster on word naming fluency than participants of group I

Interestingly, both males and females of group II performed faster for word naming fluency than males and females of group I. However, the difference was not statistically significant. Group II participants performed slightly better on semantic memory skills (i.e. word naming fluency) and this slight improvement is attributed to better experience by the older individuals (65-69.11 years). This view point has been explained before as all types of memory doesn't decline. Usually semantic memory tends to remain stable as it is more related to experience (Kamath, 2001; Lakshmi, 2010). Hence, significant difference was not seen in group I and II on word naming fluency.

Fourth, gender difference for word naming fluency was seen only on phoneme /i/ in group I

Across phonemes of word naming fluency, only phoneme /i/ showed gender difference in group I and not in group II. That is, males of group I performed better than females on phoneme /i/ for word naming fluency. Out of 5 phonemes only /i/ phoneme shown difference and rest did not show any difference. This can be attributed to the difference in education levels and/or work related exposure between males and females on word naming fluency. The present study result is line with Kim, Lee, Oh, Hong, Lee, Son and Kim (2013) who reported that higher mean score on lexical verbal fluency test (LVFT) for males than females attributed to educational difference between genders. However, previous studies showed females performed better than males on lexical fluency (Crossley, D'Arcy & Rawson, 1997; Capitani, Laiacona & Basso, 1998).

Fifth, Digit forward task is better than digit backward task in both groups.

Both groups were able to recall the digit forward task better than digit backward. This result is in consensus with previous study by Babcock Salthouse (1990) who quotes that increase in age reduces the performance of digit backward by 14% to 8 % compared to digit forward. This decline is attributed due to involvement of executive function as a whole (Pearson et al., 1999).

Elliott, Cherry, Brown, Smitherman, Jazwinski, Yu and Volaufova (2011) also states that increase in age tend to reduce the working memory abilities. In addition, back ward digit performance was poorer than forward digit performance across age group (45-90 years). This view point was attributed that back ward digit requires additional processing which is spatial in nature (Hoshi et al., 2000).

Literature also provides explanation for decline of digit tasks as storage of load is more than executive function deficit. Further, digit span includes relatively complex processing and the maximal verbal memory span mainly depends on both the phonological loop as well as central execution. When the digit load increases, demand on central executive function also increases (Baddeley, 2001).

Lastly, performance of participants was better on episodic memory followed by semantic and then by working memory.

The results of the present study revealed, irrespective of groups and gender there was a significant difference among different memory tasks. Both the group of males and females performed better on episodic memory followed by semantic and working memory. Suggesting that, episodic memory and semantic memory were less susceptible for age related changes as the recall of earlier acquired words much better than later acquired words. Further, these types of memory depend on the life circumstance of individuals. This view point is consensus with previous studies Kamath (2001) and Lakshmi (2010), who reported that episodic and semantic memory were better in both groups (60-64.11 years and 65-69.11 years) remain stable or might improve based on everyday experience. Further, organization of semantic network might not change as age increases which was proved by association tests (Boweles, Williams & Poon, 1983).

However, a performance on working memory was poorer when compared to episodic and semantic memory in both the groups and gender. Suggesting that the decline on working memory starts earlier in life than episodic and semantic memory. The poor performance in working memory tasks indicates deficit in executive function (Pearson, Logie & Gilhooly, 1999).

CHAPTER VI
SUMMARY AND CONCLUSION

The primary focus of the present study was to investigate the episodic, working and semantic memory in neuro-typical elderly individuals in the age range of 60-70 years. The Cognitive Linguistic Assessment Protocol in Kannada (CLAP-K) developed by Kamath (2001) was used to assess following aspects such as:

1) To evaluate the age related changes on episodic, working and semantic memory skills in neuro-typical elderly individuals.
2) To compare gender difference (if any) on episodic, working and semantic memory in neuro-typical elderly individuals.
3) To compare the performances between episodic, working and semantic memory in neuro-typical elderly individuals.

Generally, cognitive changes tend to occur as the age increases and cognitive decline may not be uniform across the domain. The domains of cognition are vulnerable to aging with varying degree in different individuals as well as gender difference varies in degree. Hence, the cognitive-linguistic protocol that relates these variables are the interest of research and throwing light on knowing whether their cognitive-linguistic skills remains intact or not in their later part of life.

Therefore this study was carried out to document the age and gender related changes of various memory domains (Episodic, Working and Semantic memory).

The scores of Memory domain were calculated separately for Group I and Group II and further subjected to statistical analysis using SPSS (Version 20.00) statistical package. Further, mean, median and standard deviation were computed across group for all memory domains. Between groups comparison, gender

comparison were assessed using Mann-Whitney U test. Friedman's test was done separately for group I and group II for within group comparison. Further, Wilcoxon signed ranks Test was also done to see among which pair shows significant difference across scores on Episodic, Working and Semantic memory.

Major finding of the present study is as summarized below;

a) First, no significant difference found for 3 memory domain.
b) Second, no gender difference found on memory skills in group I and group II.
c) Third, participants of group II performed faster on word naming fluency than participants of group II.
d) Fourth, gender difference for word naming fluency was seen only on phoneme /i/ in group I. And not for other phonemes and no gender difference found in group II.
e) Fifth, digit forward task is better than digit backward task in both groups.
f) Lastly, irrespective of groups and gender, performance was better on episodic memory followed by semantic and working memory.

Implications of the study

- The results of the present study augment the understanding of memory in neuro-typical elderly individuals.
- It will provide the normative data on episodic memory, working memory and semantic memory in Kannada speaking neuro-typical elderly individuals between 60-70 years.
- The result of the present study in turn will be useful in assessing and planning therapeutic intervention for elderly individuals.

Limitations of the present study

- The Cognitive Linguistic Assessment Protocol in Kannada (CLAP) taps the decline of cognitive-linguistic abilities of neuro-typical elderly individuals superficially. That is, subtle changes in cognitive-linguistic decline cannot be traced with CLAP because the task doesn't process the real complexity.
- The pattern of performance/trend of decline on episodic, working and semantic memory in neuro-typical elderly individuals was not observed owing to the tasks used in the present study were very simple for the neuro-typical elderly individuals.
- In order to trace the decline trend, very old neuro-typical individuals might have incorporated for the study. As the present study included the neuro-typical elderly individuals in the age range of 60-70 years.

Future direction of the study

- Consider more number of participants in the 70 and above old individuals.
- The complexity of tasks can be increased by including tasks such as free recall of unrelated words, working memory tasks of non-words and memory of special location (Craik, 1994).
- To trace the cognitive-linguistic decline, inclusion of both young adults as well as older individuals could highlight the cognitive performance decline (if any).
- The present study consider 5 years interval for group formation. That is, 60-65 years as group I and 65-70 years as group II. Future study can include lesser or more age interval in group formation to study the age related decline.

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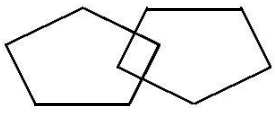
APPENDIX I

Mini-Mental State Examination (MMSE)

Name: _____ Date: _____

Maximum Score	Patient's Score	Questions
5		"What is the year? Season? Date? Day? Month?"
5		"Where are we now? State? County? Town/city? Hospital? Floor?"
3		The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible.
5		"I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, …) Alternative: "Spell WORLD backwards." (D-L-R-O-W)
3		"Earlier I told you the names of three things. Can you tell me what those were?"
2		Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.
1		"Repeat the phrase: 'No ifs, ands, or buts.'"
3		"Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)
1		"Please read this and do what it says." (Written instruction is "Close your eyes.")
1		"Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)
1		"Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.) 
30		TOTAL

APPENDIX II

NIMH Socio-Economic Status Scale, Revised Version (Venkateshan, 2011)

Name: _____ Date: _____

A.	Pooled Monthly Income		Score
	1.	Rs. 5000 or below	1
	2.	Rs. 5001 – Rs. 10000	2
	3.	Rs. 10001 – Rs. 15000	3
	4.	Rs. 15001 – Rs. 20000	4
	5.	Rs. 20001 & above	5
B.	**Highest Education**		**Score**
	1.	Illiterate	1
	2.	Primary/Secondary School	2
	3.	Matriculation	3
	4.	Graduation	4
	5.	Post Graduation & Above	5
C.	**Occupation**		**Score**
	1.	Unskilled labor/Unemployed/Daily Wager	1
	2.	Semi-skilled Worker/Class IV Service	2
	3.	Skilled/Technical/Class III Service	3
	4.	Professional/Class II Service/Blue Collared Jobs	4
	5.	Specialized/Class I Services/White Collared Jobs	5
D.	**Family Properties (Immovable & Movable)**		**Score**
	1.	Nil or Below Rs. 50000	1
	2.	Between Rs. 50000 to Rs. 1.5 Lakhs	2
	3.	Between Rs. 1.5 Lakhs to Rs. 2.5 Lakhs	3
	4.	Between Rs. 2.5 lakhs to Rs. 5.0 Lakhs	4
	5.	Above Rs. 5.0 Lakhs	5
	Total		

Note: Circle the appropriate score and enter sum into the cell against 'Grand Total';

Interpretative Norms for Obtaining Overall SES: 0-4 is SES I; 5-8 is SES II; 9-12 is SES III; 13-16 is SES IV; 17-20 is SES V.

APPENDIX III

All India Institute of Speech & Hearing, Naimishm Campus
Manasagangothri, Mysore 570 006

Episodic, Working and Semantic memory in 60-70 year old neuro-typical individuals

Informed consent

I have understood that the present study aims to investigate episodic, working and semantic memory abilities in neuro-typical elderly individuals in the age range of 60-70 years. I know that audio recording of my conversation will be used for the same purpose. I am interested in participating in the study and give my oral/written consent. I am also aware that, only the test results will be revealed and not my personal identification.

Date: Signature of the participant

(Name:)

APPENDIX III