Verbal Recall in Individuals with Cognitive Impairment

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May, 2017

CERTIFICATE

This is to certify that this dissertation entitled **"Verbal Recall in Individuals with Cognitive Impairment"** is a bonafide work submitted in part fulfilment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 15SLP023. 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 this dissertation entitled **"Verbal Recall in Individuals with Cognitive Impairment"** has been prepared under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled "**Verbal Recall in Individuals with Cognitive Impairment"** is the result of my own study under the guidance of Dr. Abhishek B. P, Lecturer in Speech Sciences, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore, **Registration No. 15SLP023**

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Dedicated to Appa and Amma for their endless love, blessings and encouragement.

A special dedication to my guide Dr. Abhishek Sir without whose immense support and guidance this wouldn't have been possible.

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Chapter 1

Introduction

"Always remember for those who cannot".

"They may forget what you said — but they will never forget how you made them feel"

-Carl W. Buehner.

Cognition is "the mental action or process of acquiring knowledge and understanding through thought, experience and the senses (Barbara, 1996). Human cognition is conscious and unconscious, concrete or abstract, as well as intuitive and conceptual. It encompasses processes such as knowledge, attention, memory and working memory, judgement and evaluation, reasoning and computation, problem solving and decision making, comprehension and production of knowledge. Cognitive processes use existing knowledge and generate new knowledge.

Memory is a process of mind by which information is encoded, stored, and retrieved (Atkinson & Shiffrin, 1968). Memory is very important to encounter new experiences and governed by limbic systems, it is holding of information over time for the purpose of carrying out future action. If past events are not remembered, learning or developing language, relationships and personal identity is not possible (Eysenck, 2012). The Brain areas such as hippocampus, amygdala, striatum and the mammillary bodies are thought to be involved in the memory process. The hippocampus is responsible in spatial learning and declarative learning, while the amygdala is responsible in emotional memory (Labar & Cabeza, 2006).

Memory is an important process which is dealt in every moment of the day, even though it is not actively used all the time. It helps us to remember skills that we have learned, recall information that is retained in the brain and retrieve any information of the past. All information are stored in the memory assist to retrieve it, use it in proper context and also to use in the current activity involved in.

Language and cognition are highly interdependent. Simple tasks such as recalling a telephone number to complex tasks as language comprehension, formulation and production require the need to store and retrieve information in the correct order (Lewandowsky, Brown, Wright & Nimmo, 2006). Memory processes and language functions are intricately connected where language involves use of an arbitrary set of symbols (code) arranged in a prescribed manner to convey meaning. However verbal memory and language are interdependent on each other. Before an item can be stored in long-term verbal memory, it must be decoded and recognized as a linguistic item with phonological and/or semantic characteristics. The ability to retrieve an item from verbal memory depends upon the access to the verbal representation of the item. Thus, language is the medium through which these lasting impressions are conveyed at a later time. On the other hand, one way in which language is dependent upon verbal memory is that vocabulary is learned via verbal-memory functions. The acquisition of a new word and its meaning requires the use of verbal memory to enter the item into more permanent semantic storage.

One of the major concerns of older adults is that they experience memory loss, which is one of the key symptoms of cognitive impairment. However, memory loss in normal aging is qualitatively different from the kind of memory loss associated with Alzheimer's disease (Budson & Price, 2005). Research has revealed that individuals' performance declines with age on memory tasks that executed by frontal regions. Older adults tend to exhibit deficits on tasks that involve remembering the learnt information/ items in sequence (Parkin, Walter & Hunkin,1995) memory tasks that require them to remember the specific context in which they learned information (Craik, 1987) and prospective memory tasks that involve remembering to perform future acts. Complaints also often include difficulty in remembering what has been read, the key content of the conversation and location of certain objects used every day.

Similarly individuals with cognitive impairment due to pathological aging (Alzheimer's disease, multiple infarcts, Parkinsonism etc.) also exhibit memory deficits, but show marked and rapid progression. Frequent failure to remember events or episodes that most often brings the patient in the early stages of AD to professional attention.. Craik, 1986 report that normal aging is due to decreased spontaneous use of elaborate and distinctive encoding/ retrieval strategies and severe memory deficits in dementia can be considered as the exaggeration of the problem i.e. abnormally rapid forgetting of information stored in episodic memory. Many features of memory impairment in pathological aging coincide with that of normal aging, differential diagnosis becomes a major concern and biggest challenge to professionals.

One of the most commonly encountered terminologies related to memory is recall. Recall being one of the pivot aspect of memory, is an active process of reimagining the perceptions,

feelings, and possibly thoughts about the event and its context. It also refers to the recollection of any information. Many studies have proven that recall ability heavily influences complex cognitive acts such as language comprehension and formulation (Jones, 2015). Also, many studies have incorporated recall as a measure to determine the presence and severity of cognitive impairment (Visser, Verhey, Hofman, Schentels & Jolles, 2002; (Achiron, Polliack, Rao, Barak, Lavie, Appleboim & Harel, 2005). But the previous studies have not focussed on particularly measuring language specific recall abilities. As there is greater significance of recall tests in identifying memory disturbances in the initial stages of the disease compared to other tests or functions of memory, the present study was taken up.

Need for the study: As Cognitive impairment rates are becoming higher and these rates increase exponentially with age, there is a need to understand memory changes and their impact on communication in these individuals. Previous studies done on individuals with cognitive impairment have mainly focussed either on volumetric analysis of the brain, memory disturbances, predicting the cognitive decline through obvious pathological changes seen in the brain anatomy, cognitive profiling using cognitive assessment tools, identifying correlation between cognitive tests and disease duration or on identifying the biomarkers for cognitive decline. Also, the cognitive tests that are administered in the previous studies are language non- specific.

Recall being one of the important aspects of memory is uniquely linked with language abilities. The close association between recall and language processing indicates the need to understand ways in which different types of recall abilities support language functions.

Performance in recall task would reflect functioning of other stages of memory such as encoding and storage also. Recall abilities is often studied by employing digit recall task. Very few of the previous studies have specifically focussed on assessing verbal recall abilities by employing language sensitive test material in these individuals. This necessitates carrying out the present study.

Aim of the study: The purpose of this study was to explore Verbal recall abilities in persons with cognitive impairment due to neuro-degeneration and neurologically healthy individuals (paired matches) on immediate and delayed verbal recall for digits and words.

Chapter 2

Review of Literature

2.1 Cognition

Cognition is defined as a process which involves transforming, reducing, elaborating storing, recovering and using the sensory input (Neisser, 1967). Cognitive processes include perception, attention, memory, knowledge, language reasoning and problem solving. Cognitive processes use the knowledge that is existing to evoke new knowledge. They also regulate human behaviour.

2.2 Memory

Memory is a pivotal aspect of cognition. Memory is defined as a process in which the information learnt or experienced is established as a schema in the Central Nervous System (registration), persists with a variable degree of retention that can be retrieved from storage whenever required (Bryan &Whishaw, 1996). The type of information influences the retrieval attempts. Some of them may be effortless while other attempts to remember the information that is stored may be more demanding for various reasons. After linguistic analysis, information is forwarded for elaboration and association with other information. Memory can also be thought of as the use of past experience to affect or influence current behaviour. It is the ability to remember past experiences, and the power of recalling to mind previously learned facts, experiences, impressions, skills and habits. It is the store of Things that are learnt and retained from our activity or experience is stored in memory schemas. Memory schemas are in continuous modification due to structure or behaviour, or by recall and recognition.

New learning causes human memory to be in constant state of modification. Each word we read influences our memory in some way. The main role of memory is to interpret and place different important inputs from auditory, visual, kinaesthetic, olfactory modes in the specific regions of the brain.

According to Atkinson- Shiffrin's Multi store Model, memory can be understood as sequence of steps in discrete, in which information is transferred from one storage area to another.

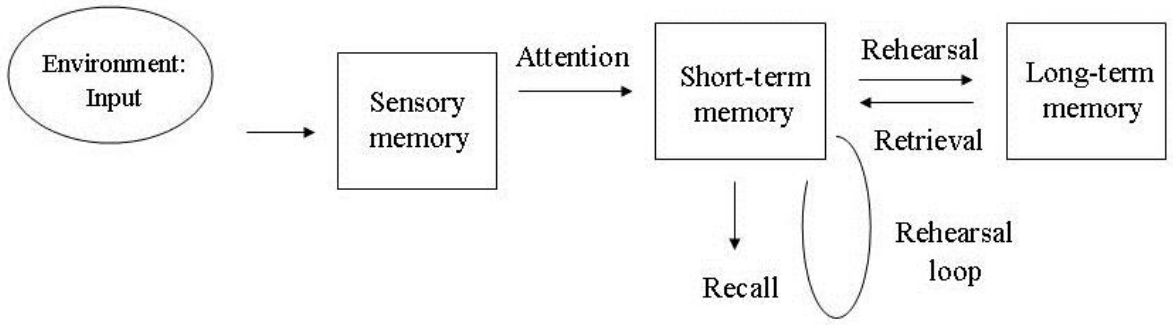

Figure1.1. 'The Multi Store Memory Model' of Attkinson-Shifirin, (1986), http://www.simplepsychology.org/memory.html.

2.2.1 Types of memory

Initial stage of memory is **s**ensory memory which is a large capacity storage system that accurately records information from the different senses. Short Term Memory is a primary memory that holds the information for a short period of time. Working memory is a limited capacity system that actively manipulates the information which is currently being maintained in attention; hence it is a divided attention task. Long Term Memory is a memory store with large capacity and contains memories that can be stored for decades, in addition to memory information stored recently. It requires retrieval/recall of information that is not present or

maintained in an active state. Current studies in cognitive linguistics considerably looked into recall abilities, which is the final stage of memory.

2.3 Recall and recognition

Recall and recognition are two commonly encountered terminologies related to memory. Recognition is the ability to recognize events, objects, or people that were encountered previously. When the previously-experienced event is again experienced, this environmental content is matched to memory representations that are stored, eliciting matching signals. Recognition requires not only a judgment about familiarity but an identification of the context in which you have encountered the person/event before. (Oh yes, I've seen her at the market).

Recall/Retrieval is an active process of reimagining the perceptions, feelings, and possibly thoughts about the event and its context. It is one of the three key processes of memory. It involves recollecting a fact, event or object that is not currently physically present and requires the directly accessing of information from memory. "Specific encoding operations performed on what is perceived determines what retrieval cues are effective in producing access to what is stored" (Tulving & Thomson, 1973). Verbal recall refers to the recollection of verbal information. Many studies suggest that symmetrical bi-lateralization of language in the brain is responsible to successful verbal recall (Marco, Mathew, Masud, Robin & Derek, 2007).

There are three different types of recall that can be recalled by two ways/patterns depending on time duration given: immediate and delayed.

a. **Immediate recall:** In immediate recall, items or information is retrieved immediately after it is heard/learnt. Here the recall period starts immediately after the final item in the presented list.

b. **Delayed recall:** In delayed recall, items or information is retrieved after given period of time after it is heard/learnt. Here, a short distraction period is inserted in between the termination of stimulus and the initiation of the response.

In order to understand the recall process in depth, recent investigations have been trying to trace the neural substrates responsible for recall.

2.3.3 Neuroanatomy of Recall process

Different brain structures are involved in the process of recall. Cabeza, Kapur, Craik, McIntosh, Houle & Tulving (1997) reported that the brain areas such as globus pallidus, thalamus, anterior cingulate cortex, and cerebellum show higher amount of activation during recall. This suggests that these components of the cerebello-frontal pathway play a important role in recall process.

According to neuroimaging data, PET studies by Kapur, Craik, Jones, Brown, Houle & Tulving (1995) consistent increases in regional cerebral blood flow (RCBF) in the following six brain regions were noticed for recall and recognition. Those area are the right prefrontal cortex, the hippocampus and parahippocampus of the medial temporal lobe, the anterior

cingulate cortex, posterior cingulate, retrosplenial precuneus, and cuneus regions, the right inferior parietal cortex and the left cerebellum.

As previously mentioned recall involves a self-initiated processing, which is also a function of the cerebellum particularly it is involved in generating the response candidates. The left inferior frontal gyrus has also been attributed to recall of recent items especially in memory interference resolution (Oztekin, McElree, Staresina & Davachi, 2008).

Through the above mentioned research data, we can infer that hippocampus, cingulate cortex, pre frontal cortex, globus pallidus, thalamus and cerebellum are the major areas in the brain involved in the process of recall and damage to one or more than one of these regions would definitely affect the recall abilities.

Language and cognition are closely connected. Language comprehension and formulation are considered as the complex cognitive acts. Difficulty in recalling is the most significant problem human beings face.

2.4 Language and Recall:

Language and recall are highly interdependent. Gunter & Jackson, 1998 stated that the stronger activation of semantic networks which would result in successful lexical access is possible only when the recall ability is intact. Jones (2015) reported that recall ability heavily influences naming and verbal fluency skills. Lewis, Vasishth and Van Dyke (2006) described a computational model of sentence processing which emphasizes that recall is necessary for accurate sentence processing.

Martin and Saffran, 1997 reported that memory and language are highly linked systems and recall is primarily influenced by the activation of phonological representations. Also, there is interactive activation happening between phonological, lexical and semantic representational levels of words not only in the production and comprehension of isolated words, but also in the short term maintenance of series of verbal information.

Deepa and Chengappa (2012) investigated the cognitive linguistic functions in bilingual persons with mild dementia. The performance of individuals with mild dementia were further compared with the normal elderly. Interpreting the results obtained, it was concluded that degenerative changes in Central Nervous System seem to affect especially the complex forms of language. However these changes do not disturb the symbolic aspects of language and the disorders lie primarily in the cognitive aspects of language.

Neisser (2000) reported that overall effect of a linguistic ambiance influences recall. Language in which one carries out the mental activity creates an internal context to facilitate verbal recall. And also, memory becomes more easily accessible when the linguistic environment at recall is rightly matched with the linguistic environment at encoding. These findings suggest that recall is uniquely linked with language abilities.

2.5 Aging and recall

Aging is a normal phenomenon. Advanced aging is often associated with changes in brain morphology and structure. Several examinations of brain tissue have revealed a varied array of age related changes in the brain. Theories of ageing explains decline in the performance across age in a variety of tasks, either with respect to a deficit in the core cognitive function, or according to deficits in set of cognitive functions like processing speed (Salthouse, 1996), inhibition (Zacks & Hasher, 1988), capacity of working memory (Craik, Morris & Gick, 1990) and attention (West & Bell, 1997). It is well known that ageing interact with memory performance and among the memory processes recall is affected the most.

a) Normal aging and Pathological aging

Normal aging is a consequence of natural maturational processes. Cognitive aging is complex and it is the age related decline in the mental functions such as memory, executive functioning, processing speed, and reasoning and multi-tasking which are critical for everyday functioning. There exist a dynamic relationship between brain and cognition and may change across the life span.

Cognitive impairment can be described as any characteristic that acts as a barrier to cognitive process (Stanley, 1999).Understanding cognitive change due to aging will help to realize that these changes in cognition are not uniform across all cognitive domains. Attention and memory are the basic cognitive functions most affected by age. Older adults exhibit significant deficits in tasks that involve actively manipulating, reorganising or integrating the

contents of working memory. Speed of information processing and the ability to inhibit irrelevant information are impaired leading to ineffective performance of these higher level cognitive tasks

Long Term Memory which requires recollection of information that is not present or maintained in an active state is also affected by aging. Older adults may less meaningfully encode the new information or with less elaboration at the input stage so that memory traces are less distinctive and thereby becomes more difficult to Recall (Craik, 1983). Sometimes they also may attend to significant information but fail to take account of peripheral details. They may also have difficulty in integrating contextual aspects of an experience with central content (Glisky & Davidson, 2001). Considerable evidence has proved that retrieval/recall as a source of memory problems in aging. This can be attributed to effortful encoding strategies, storage or consolidation.

Veena & Abhishek (2016) conducted a study to analyse verbal recall abilities in neurologically healthy younger and older adults. The study considered 60 normal adults, 30 younger adults in the age range of 18-25 years and 30 older adults in the age range of 55-65 years with equal male and female participants. All the participants had Kannada as their native language The tasks were 3 syllable, 4 syllable and 5 syllable word recall, semantically related word recall, semantically unrelated word recall, digit recall and non - word recall. The results revealed that as age increased the verbal recall abilities decreased, no significant effect of gender in younger adults whereas in older adults, males performed better than females,

superior recall effect for digits than words,items recalled in related list was higher in contrast to the unrelated lists and recall of words were superior to recall of non-words.

Another study was conducted to explore the relation between priming recall and aging. Twenty young (20.5 years) and twenty middle-aged individuals (57.2 years) performed a priming-recall task presented in three blocks. Participants had to read forty word pairs (half of the word pairs were highly associated while the other half were low associated) and lter recall task had to be done. N400 potential was also recorded. Targets of N400 showed delayed and smaller in amplitude for low-associated items for the middle aged group. N400 of primes, however, showed no age related latency difference. Authors conclude that the positive shift seen in middle-aged group may indicate age differences in semantic activation (Gunter, Jackson &Mulder,1998).

Because the number of elderly people is increasing rapidly, there is an increase in neurodegenerative and cerebrovascular disorders causing pathological aging (Leite & Barkhof, 2004). Pathological aging is aging due to factors such as disease or trauma to the brain (Reese, Cherry & Copeland, 2000). Disease can be of degenerative/ non-degenerative type (Kempler, 2005).

In the last 20 years, many terms and criteria have been proposed to describe the normal aging and dementia (Pathological aging). They are:

Age associated Memory Impairment: It is a condition in which healthy individuals between the ages of 65 and 91 demonstrate significantly slower psychomotor speed than younger

adults, as well as evidence of slowing of the electrical activity of the brain as measured by EEG (Salthouse, 1985). The subtle effects on cognitive associated with this slower processing have been referred to as "benign forgetfulness" (Kral, 1962) and "age-as-sociated memory impairment" (AAMI) , Crook et al., 1986).

Mild Cognitive Impairment (MCI): The condition usually affected only in one domain (e.g. Memory) and who do not meet the clinical criteria for dementia. It causes a slight deficit but decline in cognitive abilities can be noticed and measured. Research studies have reported that the individuals with MCI are at increased risk of developing dementia (Green, 2005, Petersen, et.al., 2001; Winblad et.al;2004)

Dementia: It is a condition which causes loss of memory and other mental abilities that are severe enough to interrupt the daily life. It is caused because of the slow/rapid histopathological changes in the brain. Alzheimer's disease, Vascular dementia, Lewy body dementia, Fronto temporal dementia and Parkinson's disease are the common types of dementia . The criteria under DSM-IV defines dementia according to three domains:

-Memory impairment and related changes in another cognitive domain such as – language , abstract thinking, judgement or executive functions that are-

-Sufficiently has the severity to cause impairment in social and occupational functioning and

-that reflects a decline from previously acquired higher level of functioning.

The figure below depicts the cognitive continuum in aging:

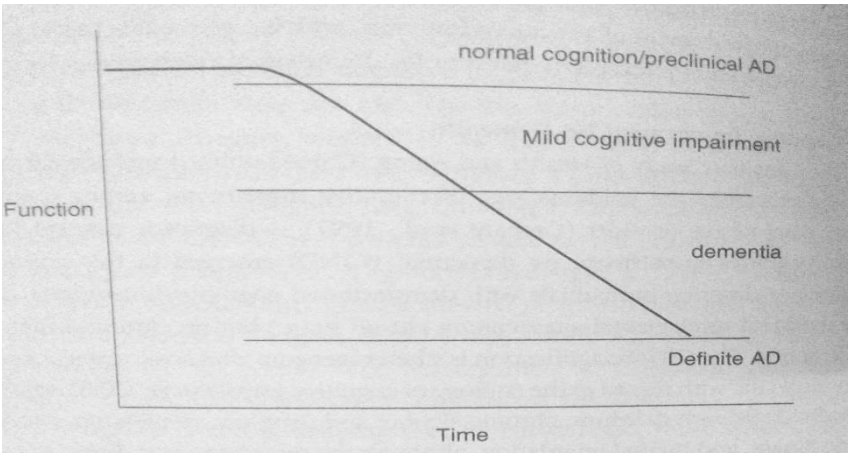

Figure 1.2. Mild Cognitive Impairment as an intermediate stage in the longitudinal course of Alzheimer's disease. (Adapted from Mild Cognitive Impairment as a diagnostic entity, Peterson (2004).

Peterson, 1997 also states that it is worthwhile to depict cognition as a continuum ranging from normal aging through mild cognitive impairment ultimately leading to dementia. But everyone will not experience this transition as a manifestation of aging. Hence, salient predictors of deterioration include certain aspects of learning and recall performance, apolipoprotein E status, and structural imaging features of the hippocampal regions.

Cerebral atrophy, ventricular enlargement and hippocampal atrophy are more rapid in progression and very much evident in pathological aging process (Reese, 2000). Because of this, individuals with pathological aging may confront more severe and deep rooted impairment in cognition especially in the aspects of memory, than compared to individuals

with normal aging which would act as a barrier for carrying out everyday activities, living independently, and for general health and well-being (Elias, 1995). Individuals with pathological aging may have memory disturbances ranging from mild to profound extent which would create a negative impact on their communication skills also. Many studies state that impaired cognitive skills are the root cause for underlying language deficits such as naming disorder, verbal disfluencies and perseveratory errors in these individuals (Jones, 2015).Many research studies have also been focussed on understanding, predicting and profiling the cognitive decline especially in regard to memory in individuals with cognitive impairment.

b) Recall abilities in individuals with cognitive impairment

Recall is one of the important stages of memory. It is a well-known fact that individuals with impaired cognitive skills would exhibit some or the other sort of memory disturbance and it can be at any stages of memory i.e., encoding, storage and recall/retrieval. Considerable evidence points to recall as a source of memory problems in aging. Also, anyone or more than one type of memory can be affected in individuals who encounter cognitive decline due to pathological aging.

A study attempted at investigating cued recall in individuals with Alcoholic Korsakoff syndrome who were been prescribed bilateral Electro Convulsive therapy. 18 subjects (10 female, 8 male) were considered for the study and were compared with controls. A cued recall test consisting of lists of 24 and 45 words were administered on the subjects. Each word was presented for 4 seconds with inter word duration of 0.5 seconds.Semantic (category),

graphemic (letter) and phonemic (rhyme) cues were provided in order to facilitate recall of said words. Results revealed that in control subjects, category cues were more effective than rhyme or letter cues in eliciting recall. But patients with Korsakoff syndrome who are receiving Electro convulsive therapry failed to demonstrate normal advantage of category cue. Instead, they performed the same level of recall when given each of the three types of cues (Wetzel & Squire, 1982).

Another study assessed episodic and semantic memory to individuals with Dementia of Alzheimer's type, Huntington's disease and Alcoholic Karsakoff syndrome. Episodic memory was assessed with a task that required the recall of four short, auditorily presented passages. Semantic memory task was a fluency test in which the patient generated words beginning with a particular letter or from particular category, as quickly as possible for one minute. The results revealed that all the groups were severely and equally impaired on recall of the four passages (Butters, 1987).

With an attempt of understanding outcome in individuals with minor cognitive impairment, a study aimed at assessing whether medial temporal lobe assessment could increase the predictive accuracy of age and delayed recall for outcome in individuals with minor cognitive impairment. They had considered 31 individuals with minor cognitive impairmentolder than 50 years (n=31) from a memory clinic and were followed up for on average 1.9 years. The medial temporal lobe was assessed where volumetry of the hippocampus, volumetry of the parahippocampal gyrus, and qualitative rating of medial temporal lobe atrophy (MTA) were done. Delayed recall was tested using Auditory Verbal Learning Test (AVLT) andit was

selected as several studies have indicated that this is a strong neuropsychological predictor of Alzheimer type Dementia. The results revealed that T10 patients had cognitive decline at follow up, of whom seven had probable Alzheimer type dementia. All medial temporal lobe measurements were associated with cognitive decline at follow up. Also, all of those measures increased the predictive accuracy of age and the delayed recall score for cognitive decline (Visser, Verhey, Hofman, Schentels & Jolles, 2002).

For evaluating and characterising cognitive impairment in very early stage of Multiple sclerosis a study was conducted which considered 67 patients with probable Multiple Sclerosis. They were evaluated within a mean of one month of the onset of new neurological symptoms. The Brief Repeatable Battery Neuropsychological (BRB-N) was used. The most frequently occuring abnormality was the visual learning and recall abilities, followed by semantic verbal fluency and complex attention and concentration (Achiron & Barak, 2003).

A study was taken up with the aim of identifying correlation between cognitive tests and disease duration and also the pattern of change in cognitive abilities over time in individuals with Multiple sclerosis. It included 150 consecutive patients with MS followed at the Multiple Sclerosis Centre. The 7/24 spatial recall test (SPART 7/24), which assesses visuospatial learning, susceptibility to proactive and retroactive interference, and delayed recall, also, Paced Auditory Serial Addition Test (PASAT), which evaluates sustained attention and information processing speed were administered. The results revealed that Verbal fluency and verbal memory were affected earliest in MS. The pattern of cognitive decline was further characterised by a decrease in visuospatial learning, delayed recall,

attention and information processing speed (Achiron, Polliack, Rao, Barak, Lavie, Appleboim&Harel, 2005).

In similar lines, a study was conducted to investigate effects of lexicality on recall of words and nonwords in persons with semantic dementia and progressive non-fluent aphasia. Three individuals were considered with progressive non-fluent aphasia and two individuals were with semantic dementia.The nature of lexicality errors incurred were noted down while the participants recalled words and non word sequences. Results revealed that the in individuals with semantic dementia the greater sensitivity towards phonological attributes (phoneme length, familiarity) was observed and the patients with progressive non-fluent aphasia showed the opposite pattern (word frequency, age of acquisition and imageability). Authors interpret the results that in the presence of a focal phonological impairment, patients show an over-dependancy on preserved processing of semantic abilities. And a focal semantic impairment show dependancy on and sensitivity to phonological attributes of target words (Reilly, Troche, Paris, Park, Antonucci & Martin, 2012).

In order to analyse the cognitive decline in individuals with Alzheimer's disease,175 late middle aged participants with mean age 55.9 $\pm$5.7 years at first cognitive assessment, 70% females having available biomarkers from MRI and CSF, and being cognitively normal at baseline were recruited. Delayed recall from the Rey Auditory Verbal Learning Test; immediate and delayed recall from the Wechsler Memory Scale-Revised were administered. The results revealed that females had better performance on Rey Auditory Verbal Learning Test, more years of education had better performance on Rey Auditory Verbal Learning Test

and older baseline age had worse performance on Auditory Verbal Learning Test (Racine, Koscik, Berman, Nicholas, Clark, Okonkwo, Rowley, Asthana, Bendlin, Blennow, Zetterberg, Gleason, Carlsson& Johnson, 2016).

Along with exploring the performance of word recall in individuals with cognitive impairment, studies have also tried in looking at the performance on sentence and paragraph recall which have come up with interesting results.

A study was taken up to explore the recall of anomalous sentences in dementias and amnesia. Sixteen individuals with diagnosed Alzheimer's dementia (AD), sixteen with Korsakoff syndrome (amnesia) and sixteen healty individuals participated in the study. The participants were compared for recall of semantically anomalous sentences in immediate recall condition. Results revealed that AD patients had severe impairment in their recall of anomalous sentences but the patients with Korsakoff syndrome were not. Authors conclude that the AD patients have severe deficits of short-term memory, and this deficit make them rely on the semantic cues present in the task of immediate verbal recall. Hence, removal of these cues result in a drastic deterioration of their performance on semantic tasks indicating poor semantic processing in these individuals (Kopelman, 1986).

Brinkman, Largen, Geganoff and Pomara (1983) report that recall of verbal textual material including short stories, is considered to involve secondary memory predominantly. AD patients demonstrate deficits compared to matched controls, in recalling spoken short stories immediately. And, the level of performance in story recall shows the negative correlations with degree of cerebral atrophy and EGG slowing. They also report that when recall of stories

is tested immediately after presentation as well as after a delayed interval, Ad patients a lower percentage of retension than matched control subjects. They conclude saying that the secondary memory in AD is characterised by an abnormally rapid rate of forgetting.

Spilich (1983) investigated discourse processing in young adults, the normal aged and elderly with memory impairment, using stories designed to be of general and age-cohort interest. Sixteen young adults and thirty two elderly subjects participated and were instructed to read the passage aloud and be prepared to recall itlater. Immediately after the story reading, subjects were ased to recount the passage. The results revealed that there was an age effect for the mean number of propositions correctly recalled where young normal subjects scored the highest and normal aged scored better than the elderly with cognitive impairment. Author concludes that the young adults and old normal subjects were sensitive to the thematic structure but elders with cognitive impairment were not as efficient as the young at recalling supplemental information.

Studies on recall have also been conducted on individuals with brain damage either due to trauma or cerebrovascular accidents and tried to explore the effect of brain damage on the performance on recall tasks.

A study was conducted to investigate the recovery of cognitive function soon after stroke. Itconsidered sixty two individuals who were admitted to hospital and survived for 6 months. They were tested regularly for the first 3 months post stroke. To plot recover in aspects of

cognition such as left visual neglect was assessed using a cancellation task, attention span was tested using digit span and verbal recall was tested by counting number of words that could be remembered from a list containing 10 words. Results revealed that fifteen individuals showed recovery from visual neglect, ten showed in attention span and nine showed in verbal recall. Authors conclude that any improvement seen post stroke implies that there was some deficit at the time of stroke and that the patients recover towards their pre-stroke performance (Wade,Wood & Hewer, 1998).

Another study aimed at exploring the influence on immediate serial recall by presentation and format of recall in neurologically healthy individual and of individual with brain damage. An individual aged 50 years, female, who had massive lesions in right frontal and left temporal areas after cerebaral haemorrhages was considered for the study.Three sets of nine bisyllabic words were used including phonologically different and semantically different words, phonologically similar but semantically different words, both phonologically and semantically different words. Items were presented at the rate of one item per second with 500ms inter item interval for each of the condition. Results revealed that the individual with brain lesion showed greater semantic sensitivity than healthy individual with better recall for same words with same category. Thus, it was indicated that individual with brain lesion made greater use of information from semantics and semantic category than healthy particiants (Chasse, Belleville & Caza, 2005).

From all the above findings we can infer that recall ability is affected in individuals with cognitive impairment due to pathological aging. And a systematic review of literature, it can be inferred that recall pattern declines with normal ageing as well as in clinical conditions such as MCI and Dementia. But the cognitive tests that are administered in the previous studies are language non- specific and recall abilities is often studied by employing digit recall task. Very few of the previous studies have specifically focussed on assessing verbal recall abilities by employing language sensitive test material in these individuals. This necessitates carrying out the present study.

Chapter 3

METHOD

The purpose of the study was to explore Verbal recall in persons with cognitive impairment due to neuro-degeneration and neurologically healthy individuals. To meet the aim of the study the following conditions of recall were considered: Immediate recall, Delayed recall. Each of these conditions included further tasks such as 3 syllable, 4 syllable and 5 syllable word recall, semantically related word recall, semantically unrelated word recall, digit recall and non-word recall.

Objectives of the study:

- To compare the performance between individuals with cognitive impairment and paired matches for immediate and delayed recall of digits.
- To compare the performance between persons with cognitive impairment and paired matches for immediate and delayed recall of word list which include words of different syllable length, semantically related words, semantically unrelated words and non -words.

3.1 Participants

Participants recruited for the study were sorted into two groups. Group 1 consisted of 10 individuals above 50 years of age with cognitive impairment secondary to neuro-degeneration. All participants in group 1 were selected based on the cut-off scores (less than 26) obtained from MoCA-Montreal Cognitive Assessment Scale (Nasreddine, Bédirian,

Charbonneau, Whitehead, Collin, Cummings &Chertkow, 2005). MoCA has been standardised in various Indian languages including Kannada. It can distinguish normals, from participants with Mild Cognitive Impairment and Dementia. Further, subgrouping of the participants into MCI (5participants) and Dementia (5 participants) was done based on the average scores obtained by each participant on MoCA. Group 2 consisted of neurologically healthy pair matched individuals matched for age, gender and education with 10 individuals in group 1. Healthy normal had scored 26 or greater on MoCA. All participants considered for the study were native speakers of Kannada and informed consent was obtained from all the participants.

The participants with cognitive impairment were recruited from the old age homes and speech language therapy clinic. Out of ten participants with cognitive impairment, four were considered from speech language therapy clinic. Two of them were medically diagnosed as having dementia (one with Alzheimer's disease and another with Vascular dementia one as having Mild Cognitive Impairment and another as at risk of Dementia. Rest seven of the participants with cognitive impairment exhibited obvious symptoms of cognitive deficits and were diagnosed medically. However, relevant reports could not be obtained from the authorities of the old age homes.

Table 3.1

Demographic details of the participants in Group 1

Participant number	Age (years)	Gender	Education	MoCA scores	Diagnosis
1	73	M	Diploma	23	MCI
2	79	M	SSLC	23	MCI
3	69	M	B.Sc	23	MCI
4	72	M	SSLC	22	MCI
5	65	M	SSLC	23	MCI
6	64	M	B.Sc	13	Dementia
7	76	F	SSLC	21	Dementia
8	78	F	SSLC	16	Dementia
9	85	F	B.Sc	17	Dementia
10	60	F	B.Sc	0	Dementia

Table 3.2

Demographic details of the participants in Group 2

Participant number	Age (years)	Gender	Education	MoCA scores
1	65	M	B.A	28
2	60	F	SSLC	28
3	76	F	SSLC	28
4	82	M	B.Sc	29
5	73	F	SSLC	27
6	70	M	B.A	29
7	64	F	B.A	28
8	75	M	D.Pharma	27
9	86	M	SSLC	28
10	75	M	SSLC	26

Participant Inclusion Criteria:

Group 1:

Participants who were medically diagnosed as having cognitive impairment due to neuro-degeneration and who scored 26 or lesser on MoCA were considered.

Group 2:

Participants with no symptoms of cognitive impairment and no reported speech-language difficulties and who scored 26 or greater on MoCA were considered.

Participant Exclusion criteria

Group 1

Participants with history of trauma to the brain or cerebral vascular pathology and with known psychiatric disorders/motoric disabilities were excluded.

Group 2

Participants with previous history of trauma to the brain or cerebral vascular pathology and with known symptoms of cognitive disturbances, pyshiatric disorders/motoric disabilities were excluded.

For all the participants of both the groups, informal hearing screening was carried out to rule out hearing loss by using Ling's six sounds.

3.2 Procedure

The test protocol used in the Dissertation, 'Verbal recall abilities in younger and older adults' (Veena & Abhishek, 2016) served as the stimulus for the present study. All stimuli were presented in Kannada and the lists were recorded on CSL 4500. The presentation of the stimulus was in auditory mode. Testing was carried out in a quiet and non-distracting environment. This was carried out in two phases:

Training Phase: Two practice trials were given to the participants before the presentation of test items in auditory mode under each condition i.e. immediate recall and delayed recall. After the training phase, participants were presented with the test items. Materials that were

used for the practice trials were not included in the test trials. However, they were constructed in similar ways to the stimulus used in testing phase.

Testing Phase: After the training phase, participants were presented with the test items. If required/asked, once repeated presentation of the stimuli was allowed. In the immediate recall condition, participants were instructed to recall the units soon after the presentation of the stimulus in any order of presentation of stimulus. In contrast, in the delayed recall condition, participants were instructed to recall the units after a delay of 2 minutes in any order of presentation. During the delay of 2 minutes, participants were made to repeat the number '1234' verbally to prevent rehearsal of the stimulus. Reciting numbers to prevent rehearsal was used for the word recall tasks and for the digit recall tasks, participants will be made to repeat alphabets aloud 'jacbd' to prevent rehearsal. The sets were counterbalanced in the order of presentation to minimize practice effects.

Each of the Participants was tested individually with one session lasting for about 30 minutes in 7(tasks x conditions) experimental conditions. They were made to sit in a comfortable posture. The stimulus was presented in the auditory mode through headphones. A string of eight units was presented one after the other, each with an inter stimulus duration of 2 seconds. The testing was carried out in the order of immediate recall and delayed recall across 7 tasks (3 syllable, 4 syllable and 5 syllable word recall, semantically related word recall, semantically unrelated word recall, digit recall and non - word recall). The participants could recall the words in any order and were not provided with any phonemic/ semantic cue in the entire testing. The responses of the participants were recorded using voice Recorder.

Test conditions

The testing was carried out for two conditions namely, Immediate recall and Delayed recall and each condition mainly consisted of seven tasks and are depicted in the figure 2.

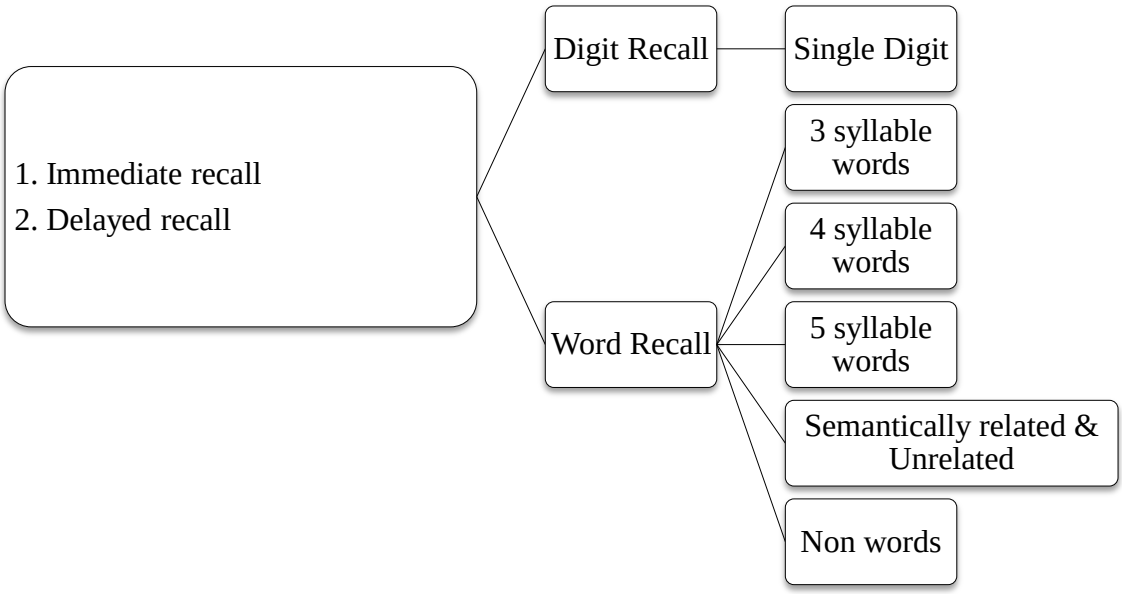

Figure 3.1..Depiction of test conditions and tasks.

Description of the tasks:

1. Word recall: This task comprised of 3 subtasks with syllable length varying from three to five syllables. These words were taken from Morpho-phoenemic analysis in Kannada (Ranganath, 1983).

i. Three syllable word recall: e.g.; ba:gilu, mamate, devaru, janani.

ii. Four syllable word recall: e.g.; gaDiya:ra, guruva:ra, nagegaLu.

iii. Five syllable word recall: e.g.; vya:vaharika, paNigrahaNa, utpadaneya.

2. Semantically related word recall: In this task, 2 semantically similar lists were assembled. Each list comprised of 8 words from the same semantic category. Examples include:

i. Animals (huli, a:ne, simha, ko:thi etc.,)

ii. Household objects (lo:ta, tatte, cha:ku etc.,).

The stimulus was adopted from Lexical semantic processing in persons with bilingual aphasia (Abhishek & Prema, 2014).

3. Semantically unrelated word recall: In this task, 10 items distinct from each otherwith respect to their semantic category were used. This was prepared by mixing thewords from different semantic categories. The stimulus for this task was also adoptedfrom Lexical semantic processing in persons with bilingual aphasia (Abhishek & Prema, 2014).

4. Digit recall: Single digits were used for this task. The stimulus material for this task was adopted from Cognitive Linguistic Assessment Protocol abbreviated as CLAP (Aruna & Prema, 2001). e.g.: 3, 4, 6, 7.

5. Non-word recall: In this task participants were made to recall non-words of 3 -5 syllable length. The non-words were prepared by transposing the syllables in the true words. E.g: garasaga (garagasa), thipa:cha (chapathi), shanega (ganesha). The stimuli for non-words were taken from Non-word Repetition in Children with Language Impairment: An Exploratory Study (Shylaja & Swapna, 2010).

3.5 Analysis and Scoring

Quantitative and Qualitative analysis of the data was carried out.

Quantitative: A maximum score of '1' was given for each set that is recalled appropriately irrespective of order and a score of '0' was given if the participants recall is not appropriate at any level. Scoring wasbe done separately for immediate recall and delayed recall.

Qualitative: The error responses were analyzed in terms of:

Type of errors

- ***Omissions:*** Whether the participants missed out any items from the stimuli presented.
- ***Transpositions:*** Whether the order of item was reversed.
- ***Repetitions:*** Whether the participant repeated the same item again and again.
- ***Deletions:*** Whether the participant deleted any or part of the word resulting in partial responses.
- ***Intrusion errors***: Irrelevant responses, addition of responses or interjections of old responses or new ones.
- ***Semantic and Phonological errors:*** Whether the substituted word was related to the target word semantically or phonemically was also verified.
- ***Primacy and Recency effects:*** Primacy effects were measured by counting the number of words that participants were able to recall and matching them with any of the first three items in the target list. Recency effects were measured by counting the number of recalls matching any of the last three items in the target list. Items marked under primacy and recency effect were analyzed separately.

Statistical analysis: Statistical analysis (non-parametric test statistics) was carried out by employing SPSS software version 21.0.

Chapter 4

Results and Discussion

The primary aim of the study was to analyse verbal recall abilities in persons with cognitive impairment due to neuro-degeneration and neurologically healthy individuals (paired matches) on immediate and delayed verbal recall for digits and words. Two different conditions (immediate recall and delayed recall) were considered for the study across 7 tasks with 3 syllable words, 4 syllable, words, 5 syllable words, semantically related words, semantically unrelated words, digits and non-words as stimuli. 20 participants were recruited for the study; these participants were divided into two groups. Group 1 comprised of 10 participants above 50 years of age with cognitive impairment secondary to neuro-degeneration and Group 2 consisted of neurologically healthy paired match participants: matched for age, gender and education with 10 participants in group 1. In Group 1, further sub grouping of participants in group 1a and group 1b was made where group 1a comprised of 5 participants with MCI and group 1b comprised of 5 participants with Dementia. Qualitative and quantitative analysis were carried out in which quantitative analysis was carried out using Statistical Package for Social Sciences (SPSS) software version 21. The p value obtained was <0.05 depicting that the data was non-normally distributed or skewed. As the data was non-normally distributed and was not meeting the assumptions of the parametric test statistics, non-parametric test statistics was applied. It was used to compare the performance of participants on immediate and delayed recall tasks.

The objectives of the study are:

- To compare the performance between individuals with cognitive impairment and paired matches for immediate and delayed recall of digits.
- To compare the performance between persons with cognitive impairment and paired matches for immediate and delayed recall of word list which include words of different syllable length, semantically related words, semantically unrelated words and non -words.
- To compare the performance between individuals with MCI and Dementia for immediate and delayed recall of digits.
- To compare the performance between persons with MCI and Dementia for immediate and delayed recall of word list which include words of different syllable length, semantically related words, semantically unrelated words and non -words.

The results of the present study are discussed under the following headings;

A) Quantitative Analysis

To address objective 1, verbal recall abilities between individuals with cognitive impairment and neurologically healthy paired matches were compared for immediate and delayed recall of digits.

To address objective 2, verbal recall abilities betweenpersons with cognitive impairment and neurologically healthy paired matches were compared for immediate and delayed recall of word list. In word list, comparisons were made for words of different syllable length (3 syllables vs. 4 syllables vs. 5 syllables), semantically related and unrelated words and non – words.

To address objective 3, verbal recall abilities between individuals with MCI and Dementia were compared for immediate and delayed recall of digits.

To address objective 4, verbal recall abilities betweenpersons with MCI and Dementia were compared for immediate and delayed recall of word list. In word list, comparisons were made for words of different syllable length (3 syllables vs. 4 syllables vs. 5 syllables), semantically related and unrelated words and non –words.

B) Qualitative analysis

Recency and Primacy effects during recall and error analysis during recallability in persons with cognitive impairment and paired matches were qualitatively analyzed.

A) Quantitative analysis:

Objective 1;

The overall mean, standard deviation (SD) and median were calculated for Group 1 (cognitive impairment) and Group 2 (neurologically healthy individuals) across two conditions, immediate recall and delayed recall for a task of digit recall.

Table 4.1

Performance of Group 1 and Group 2 across two conditions of a digit recall task.

Task		Group1			Group2		
		Mean	SD	Median	Mean	SD	Median
Digit recall	Immediate recall	9.3	3.43	10	12.4	1.17	12.5
	Delayed recall	4.8	3.58	5.5	9.8	1.47	10

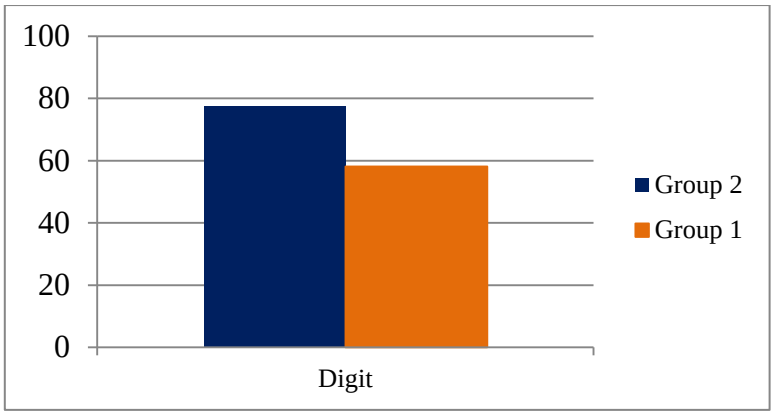

Figure 4.1: Mean percentage scores for Group 1 and Group 2 for immediate recall of digits.

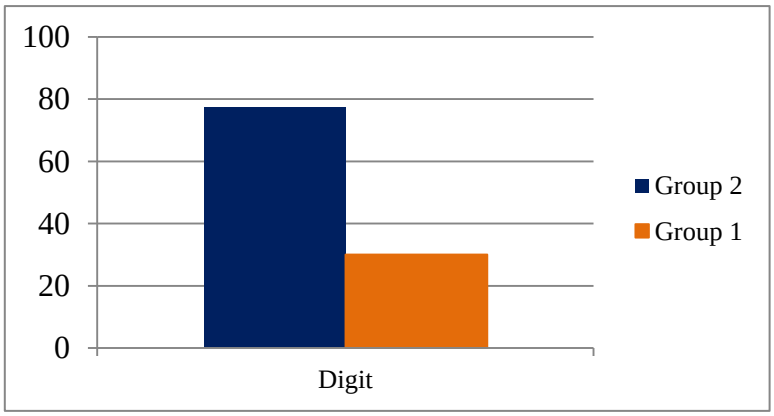

Figure 4.2: Mean percentage scores for Group 1 and Group 2 for delayed recall of digits.

As depicted in table 4.1, Group 1 performed poorly than Group 2 in the immediate recall of digits task. Similar trend was seen in delayed recall of digits task, where the performance of Group 2 was also poorer to that of Group 2. Median was also in the same direction and standard deviation was almost same for both the groups. From figure 4.1, it can also be observed that for both the groups the mean percentage scores of immediate recall of digits task is higher compared to delayed recall of digits task.

Further statistical analysis was carried out to verify if there was any significant difference between the groups for performance in immediate and delayed recall of digits task. As the data did not follow the properties of normal distribution, non- parametric Man Whitney U test was used. It revealed significant difference between the two groups on both digit immediate and digit delayed recall tasks. i.e., in digit immediate recall $|Z|= 3.203$, $p<0.05$and digit delayed recall $|Z|= 3.377$, $p<0.05$.

From the results obtained, it can be inferred that verbal recall abilities of digits were significantly higher for neurologically healthy individuals compared to the participants with cognitive impairment. Similar findings were reported from the study by Thomas, Steven, Martin & Donald, (1980) where effectiveness of digit recall was significantly reduced in aged individuals with memory impairment than in persons with normal brain functioning. Dallet (2014) reported that digit recall is largely governed by the strength of short term memory which involves unrecoded replica of stimulus input. Hulme, Lee & Brown (1993) report significant short term memory deficits in individuals with cognitive impairment due to

Alzheimer's disease. Hence, poor performance of participants with cognitive impairment in recall of digits can be attributed to the significant verbal short term memory deficits existing in these participants.

Objective 2;

The mean, median and standard deviation scores of Group 1 and Group 2 on immediate and delayed word recall(3 syllables, 4 syllables and 5 syllables) were calculated. Details are depicted in Table 4.2

Table 4.2

Performance of Group 1 and Group 2 on immediate recall of words (*3 syllables, 4 syllables and 5 syllables)*

Task		Group1			Group2	
	Mean	SD	Median	Mean	SD	Median
3 SYL	6.5	3.47	7	9.6	0.84	10
4 SYL	4.4	2.75	4.5	9.2	1.93	9
5 SYL	3.5	2.99	3.5	7.8	1.22	8

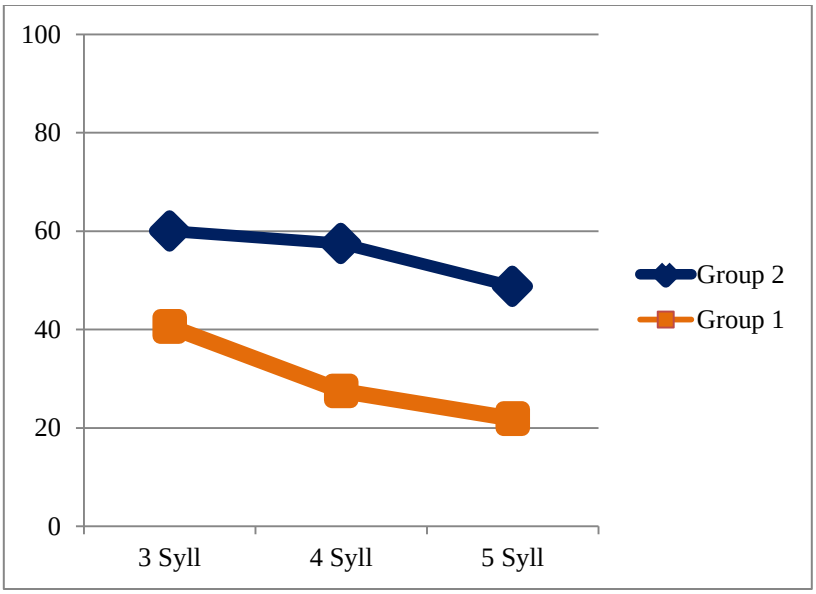

Figure 4.3. Mean percentage scores of Group 1 and Group 2 for immediate recall of words (*3 syllables, 4 syllables and 5 syllables)*

Table 4.3

Performance of Group 1 and Group 2 on delayed recall of words (*3 syllables, 4 syllables and 5 syllables)*

Task		Group 1			Group2	
	Mean	SD	Median	Mean	SD	Median
3 SYL	3.9	2.33	4.5	7.1	1.19	7
4 SYL	2.3	2.31	2	6.9	1.19	7
5 SYL D	1.9	2.33	1	6.2	1.03	6

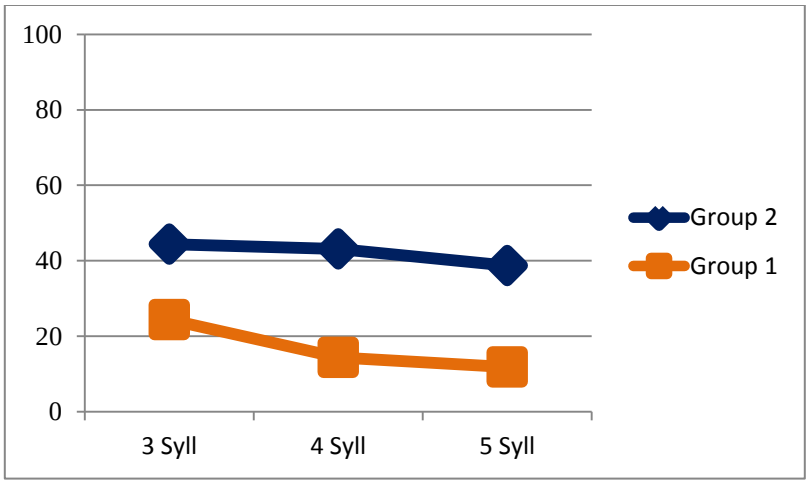

Figure 4.4. Mean percentage scores of Group 1 and Group 2 on delayed recall of words (*3 syllables, 4 syllables and 5 syllables)*

It is evident from the tables 4.2 and 4.3 that the Group 1 has performed poorly than Group 2 in both immediate and delayed recall of words (3 syllables, 4 syllables and 5 syllables). From figure 4.3 and 4.4 it can also be observed that for both the groups, the mean percentage scores of immediate recall of words task are higher compared to delayed recall of words task.

Further statistical analysis was carried out to verify if there was any significant difference between the groups for the performance on immediate and delayed recall of words. As the data did not follow the properties of normal distribution, non- parametric Man Whitney U test was used. It revealed significant difference between the two groups on both immediate and delayed recall of words (3 syllables, 4 syllables and 5 syllables) i.e., in 3 syllable word immediate recall $|Z|= 2.351$, $p<0.05$; 4 syllable word immediate recall $|Z|= 3.354$, $p<0.05$; 5 syllable word immediate recall $|Z|= 3.130$, $p<0.05$; 3 syllable word delayed recall $|Z|= 3.211$, $p<0.05$; 4 syllable word delayed recall $|Z|= 3.591$, $p<0.05$ and 5 syllable word delayed recall $|Z|= 3.468$, $p<0.05$.

The results indicated that the verbal recall abilities for words with different complexity differed significantly between the participants with cognitive impairment and neurologically healthy individuals. The same trend was observed for digits also. The obtained results are in support with the findings by Achiron and Barak, 2003; Achiron, Polliack, Rao, Barak, Lavie, Appleboim and Harel, 2005 where they also noticed significant decline in word recall abilities in individuals with cognitive impairment compared to individuals with normal aging. Poor verbal recall abilities can be interpreted based on either the morphological changes associated which include a rapid decline in total brain volume, cortical thinning and gray matter atrophy, medial temporal lobe atrophy (Raz et al., 1997) or to the decline in the core cognitive functions like speed of information processing (Salthouse, 1996), lack of inhibition or due to poor working memory capacity (Craik, Morris & Gick, 1990). According to Raz et al., 1997 the prominent changes due to pathological aging are seen in the prefrontal cortex (PFC), frontal cortex (FC) and medial temporal lobe(MTL), areas often attributed to the process of recall attempt (Tulving, 1983). It can also be implied that decline in word recall abilities can be due to this atrophy in the PFC, FC and MTL, areas primarily responsible for controlling the processes of memory. Gainotti, Marra, Villa, Parlato and Chiarotti (1998) reported that affected verbal recall is because of difficulty in encoding of new information and consolidating information into long term memory.

In addition to the preset objective, it can also be noticed from the above findings that performance has decreased with increase in complexity of words in both the groups. Further non-parametric Friedman's test was used to see if there was any significant difference in

performance within the group 1 for words with different complexity (3 syllables, 4 syllables and 5 syllables). The results revealed that there was no significant difference obtained within 3 syllable, 4 syllable and 5 syllable words in group 1 for both immediate [χ^2 (2) = 3.267, p>0.05] and delayed recall [χ^2 (2) = 4.667, p>0.05] of words. Similarly, non-parametric Friedman's test was also used to see if there was any significant difference in performance within the group 2 for words with different complexity (3 syllables, 4 syllables and 5 syllables). The results revealed that there was no significant difference obtained within 3 syllable, 4 syllable and 5 syllable words in group 2 for both immediate [χ^2 (2) = 9.135, p>0.05] and delayed recall [χ^2 (2) = 6.741, p>0.05] of words. Hence within both group 1 and group 2, word complexity had no effect on the performance of immediate and delayed recall of words.

It can be inferred that the performance decreased with increase in word length in both the groups though not statistically significant. The poor performance in longer words (5 syllables) than in shorter words (3 syllables) can be attributed to the higher load on working memory capacity involved in retaining and retrieving stimuli with greater complexity, (Baddeley,1986). According to Baddeley's Working memory model, the phonological loop of the WM stores the memory traces of the phonological information of the target words temporarily and the traces are prevented from decay by the sub vocal rehearsal mechanism. The trace can be refreshed by this rehearsing only if the time required to pronounce these items internally is less than the time required for trace degradation. As the length of the word increases, the pronunciation time for each word also increase and hence sub vocal rehearsal of

the segments would be difficult as the trace decays rapidly contributing the poor performance of longer words.

In the same lines, the mean, median and standard deviation scores of Group 1 and Group 2 on immediate and delayed word recall (semantically related and semantically unrelated) were calculated. Details are depicted below.

Table 4.4

Performance of Group 1 and Group 2 for immediate recall of semantically related and semantically unrelated words.

Task	Group1			Group2		
	Mean	SD	Median	Mean	SD	Median
SR	8	4.92	9	12.5	1.26	13
SUR	5.2	2.52	5.5	9.8	1.03	10

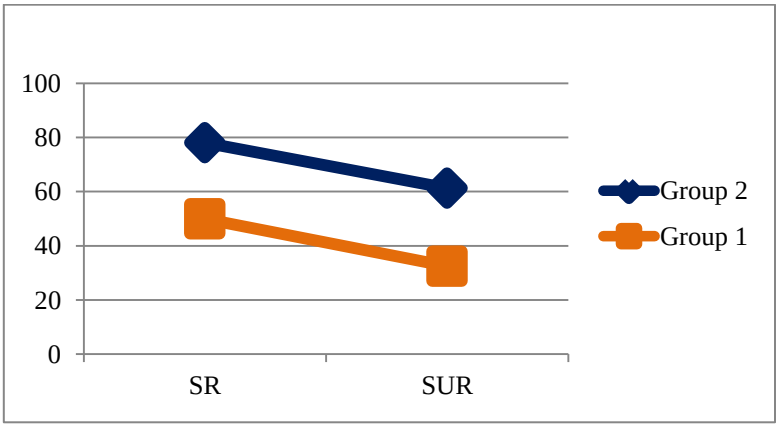

Figure 4.5. Mean percentage scores of Group 1 and Group 2 on immediate recall of semantically related and semantically unrelated words.

Table 4.5

Performance of Group 1 and Group 2 for delayed recall of semantically related and semantically unrelated words.

Task	Group1			Group2		
	Mean	SD	Median	Mean	SD	Median
SR	5.4	3.50	5.5	11.1	2.02	10.5
SUR	2.9	2.18	8.0	7.7	1.33	8

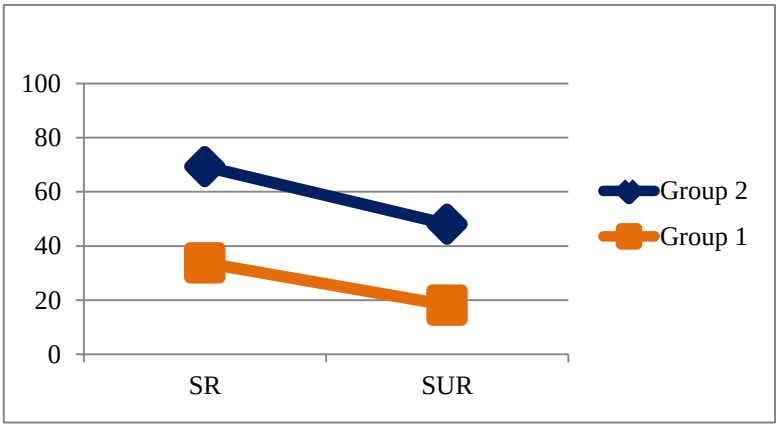

Figure 4.6. Mean percentage scores of Group 1 and Group 2 on delayed recall of semantically related and semantically unrelated words.

From the table 4.4 and 4.5, it can be noticed that group 1 has obtained poorer mean scores compared to group 2 on both immediate and delayed recall of semantically related and semantically unrelated words. Median was also in the same direction and standard deviation was almost same for both the groups. From figure 4.5 and 4.6 it is evident that performance of immediate recall of semantically related and semantically unrelated words is superior to delayed recall of semantically related and semantically unrelated words in both the groups.

Further statistical analysis was carried out to verify if there was any significant difference between the groups for the performance on immediate and delayed recall of semantically related and semantically unrelated words. As the data did not follow the properties of normal distribution, non- parametric Man Whitney U test was used. It revealed significant difference between the two groups on immediate recall of semantically related, semantically unrelated words, delayed recall of semantically related and semantically unrelated words. i.e., in semantically related word immediate recall $|Z|= 2.388$, $p<0.05$; semantically unrelated word immediate recall $|Z|= 3.729$, $p<0.05$; semantically related word delayed recall $|Z|= 3.463$, $p<0.05$; semantically unrelated word delayed recall $|Z|= 3.653$, $p<0.05$; This indicated that verbal recall abilities for words with semantic relatedness and semantically not related differed significantly between the groups (participants with cognitive impairment and neurologically healthy individuals).

Results indicated the poor performance in individuals with cognitive impairment for both semantically related and unrelated word recall task compared to neurologically healthy individuals. This can be attributed to a rapid degradation of the stored semantic network, an impaired ability to retrieve items from the semantic network at will in these individuals, (Rogers & Friedman, 2008). A study by Giffard, Desgranges, Mary, Lalevée, Sayette, Pasquier & Eustache, (2001) also indicated similar findings. They reported that individuals with cognitive impairment have semantic memory disturbances which affect the storage of concepts and words within a hierarchial semantic network.

The results also indicated that the performance was relatively poor for recall of semantically unrelated words than for recall of semantically related words in both the groups. Further non

parametric Wilcoxon Signed rank test was used to see whether there was any significant difference in the performance between immediate recall of semantically related and semantically unrelated words and also between delayed recall of semantically related and semantically unrelated words within group 1. It revealed that, the performance between immediate recall of semantically related and semantically unrelated words did not show any statistical difference within group 1 for immediate recall of semantically related and semantically unrelated words $|Z|=1.722$, $p>0.05$. However, the performance between delayed recall of semantically related and semantically unrelated words also showed statistical difference within group 1. i.e delayed recall of semantically related and semantically unrelated words $|Z|=2.410$, $p<0.05$.

Wilcoxon Signed rank test was used to verify if whether there was any significant difference in the performance between immediate recall of semantically related and semantically unrelated words and between delayed recall of semantically related and semantically unrelated words within group 2 also. It revealed that, the performance between immediate recall of semantically related and semantically unrelated words showed statistical difference within group 1. i.e. immediate recall of semantically related and semantically unrelated words $|Z|=2.677$, $p<0.05$. Similarly, the performance between delayed recall of semantically related and semantically unrelated words also showed statistical difference within group 2. i.e delayed recall of semantically related and semantically unrelated words $|Z|= 2.680$, $p<0.05$.

The better performance of verbal recall on semantically related words compared to semantically unrelated words was noticed. This can be attributed to the fact that lexical

category will contribute to the increased probability of recalling the long-term representations for items from related category. This could be either because the category itself might supplement as a retrieval cue (Crowder, 1979; Poirier & Saint-Aubin, 1995; Saint-Aubin & Poirier, 1999) or because the long-term representations of these similar items would be activated to a higher extent due to their long-term associative links (Stuart & Hulme, 2000). The findings also draws support from the study by Andre and Sola (1976) in reading where better recall of the text was found when the reader was encouraged to make semantic elaborations on the text material, which again signifies the importance of semantics in recall. Reaction time studies have also yielded similar results, wherein the reaction time for semantically related words were better compared to unrelated words, which were attributed to the semantic priming effects (Krishnan & Tiwari, 2010).

Further, the mean, median and standard deviation scores of Group 1 and Group 2 on immediate and delayed recall of non-words were also calculated. Details are depicted below.

Table 4.6

Performance of Group 1 and Group 2 on immediate and delayed recall of non-words.

Task		Group1			Group2		
		Mean	SD	Median	Mean	SD	Median
Non-words	Immediate recall	0.6	1.07	0	2.5	1.58	3
	Delayed recall	0.10	0.31	0	2	1.56	2

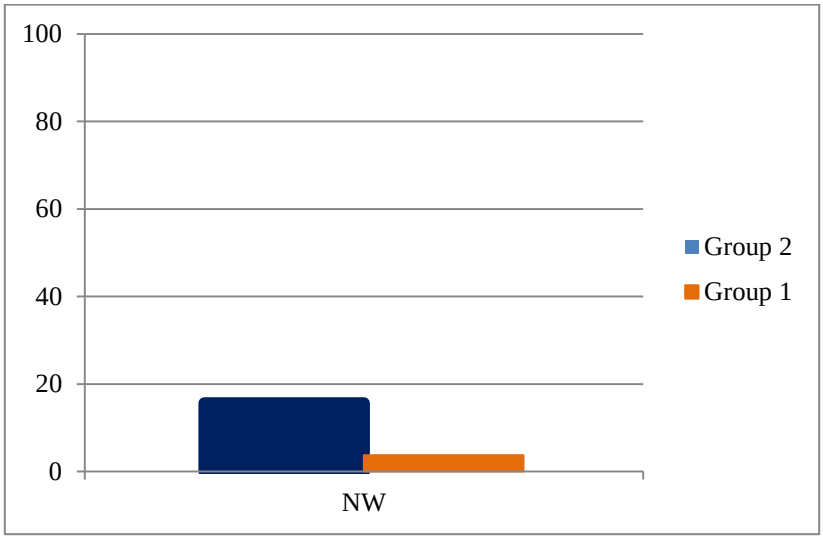

Figure 4.7. Mean percentage scores of Group 1 and Group 2 on immediate recall of non-words.

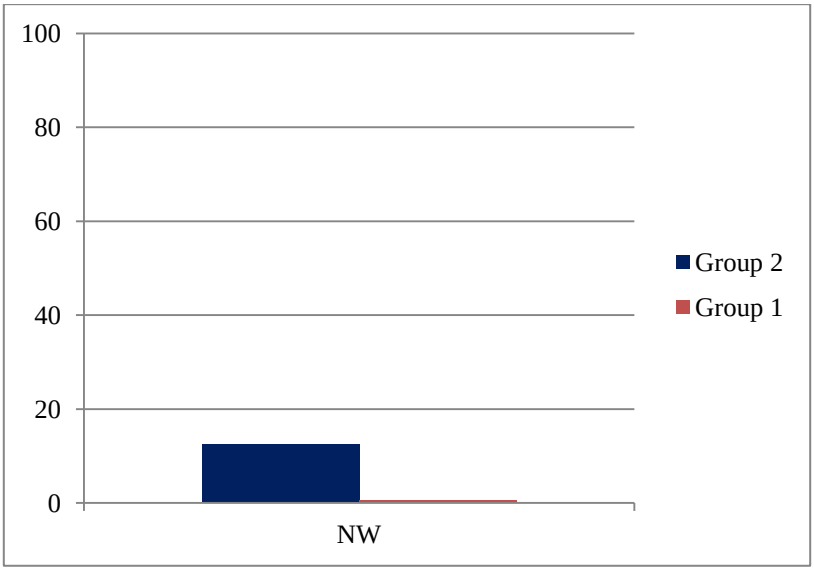

Figure 4.8. Mean percentage scores of Group 1 and Group 2 for delayed recall of non-words.

From Table 4.6, it can be noted that though the performance on both immediate and delayed recall of non-words was poorer in both the groups, group 2 has scored slightly higher than

group 1 on both immediate and delayed recall of non-words. As the data did not follow the properties of normal distribution, non- parametric Man Whitney U test was used. It revealed significant difference for both immediate and delayed recall of non-words. i.e. in immediate recall of non-words |Z|= 2.62, $p<0.05$ and in delayed recall of non-words |Z|= 2.867, $p<0.05$.

From the above findings, it can be noticed that the performance in both immediate and delayed recall of non-words was significantly reduced in both the groups. In order to verify whether there was any difference in performance between immediate recall of words (4 syllable words) and non-words and between delayed recall of words (4 syllable words) and non-words within group 1, non- parametric Wilcoxon Signed rank test was used. The results revealed that, the performance between immediate recall of immediate recall of words (4 syllable words) and non-words showed statistical difference within group 1. i.e immediate recall of semantically related and semantically unrelated words |Z|=2.536, $p<0.05$ within group 1. Similarly, the performance between delayed recall of words (4 syllable words) and non-words also showed statistical difference within group 1. i.e delayed recall of words (4 syllable words) and non-words |Z|=2.232, $p<0.05$.

Similarly, in order to see whether there was any difference in performance between immediate recall of words (4 syllable words) and non-words and between delayed recall of words (4 syllable words) and non-words within group 2, non- parametric Wilcoxon Signed rank test was used. The results revealed that, the performance between immediate recall of words (4 syllable words) and non-words also showed statistical difference within group 2. i.e immediate recall of semantically related and semantically unrelated words |Z|=2.820, $p<0.05$

within group 2. Likewise, the performance between delayed recall of words (4 syllable words) and non-words also showed statistical difference within group 2. i.e delayed recall of words (4 syllable words) and non-words $|Z|= 2.831$, $p<0.05$.

Above results indicated that performance in recall of non-words is significantly reduced in both the groups. However neurologically healthy individuals scored slightly higher than individuals with cognitive impairment. This difference in the performance between the groups can be attributed to the fact that individuals with cognitive impairment exhibit greater sensitivity to phonological attributes such as phoneme length and familiarity, (Reilly, Troche, Paris, Park, Antonucci & Martin, 2012) because of their impaired phonological encoding and impaired phonological short term memory system, they have difficulty in retaining and retrieving non-words which are just strings of phonemes/syllables which may not carry any meaning.

It was also observed that the participants in both the groups performed superior in word recall task compared to non-word recall task. This can be because of the fact that during word recall task the long term semantic representations of the words get activated and facilitates in recall. For non-word recall, this semantic representation is not available (Schweikert, 1993). While recalling words, even if the memory trace has been decayed, the existing long term representations helps to reconstruct the to-be remembered items, whereas this is not available for the non-words. Similar findings were obtained from the study by Saint-Aubin and Poirier (2000) who reported that minim duration of long-term representations to be responsible for their lower item recall.

Objective 3

The mean, standard deviation (SD) and median were calculated for the performance of Group 1a (MCI) and Group 1b (Dementia) for immediate and delayed recall of digits. Table 4.7 shows the performance of both the groups for the task.

Table 4.7

Performance of Group 1a and Group 1b for immediate and delayed recall of digits.

Task		Group1a			Group1b		
		Mean	SD	Median	Mean	SD	Median
Digit recall	Immediate recall	10.4	1.51	11	8.2	4.6	10
	Delayed recall	6.2	3.7	7	3.4	3.2	5

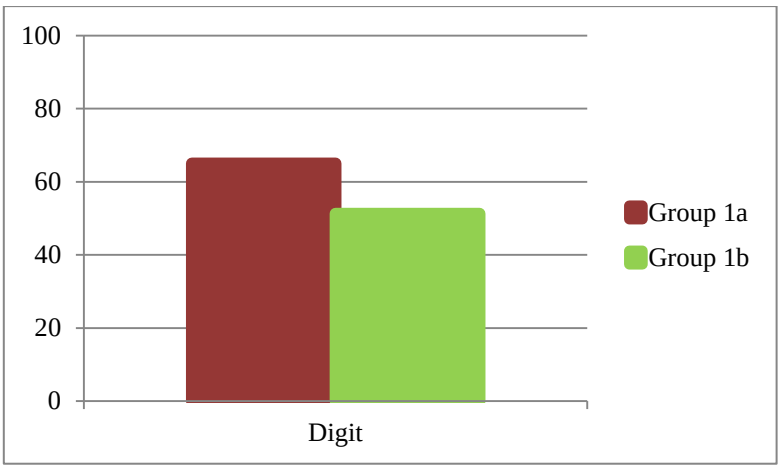

*Figure 4.9.*Mean percentage scores of Group 1a and Group 1b on immediate recall of digits.

As it can be noticed in the table 4.7, the performance of group 1a is superior to that of group 1b for immediate recall of digits. Similar trend was noticed between the groups for delayed recall of digits as well. Man Whitney U test was used to test statistical significance within groups as the data did not follow normal distribution. There was no significant difference found between the performance of group 1a and group 1b for immediate recall of digits task $|Z|=1.092$, $p>0.05$. Likewise, in delayed recall of digits task also, there was no significant difference between group 1a and group 1b $|Z|=1.494$, $p>0.05$

Objective 4,

The mean, standard deviation (SD) and median were calculated for the performance of Group 1a (MCI) and Group 1b (Dementia) for immediate and delayed recall of words with different syllable length (3 syllables vs. 4 syllables vs. 5 syllables). Details are depicted below.

Table 4.8

Performance of Group 1a and Group 1b for immediate recall of words (3 syllables vs. 4 syllables vs. 5 syllables)

Task		Group1a			Group1b	
	Mean	SD	Median	Mean	SD	Median
3 SYL	8.2	2.5	9	4.8	3.63	6
4 SYL	5.4	2.79	6	3.4	2.6	3
5 SY	4.6	2.96	5	2.4	2.88	2

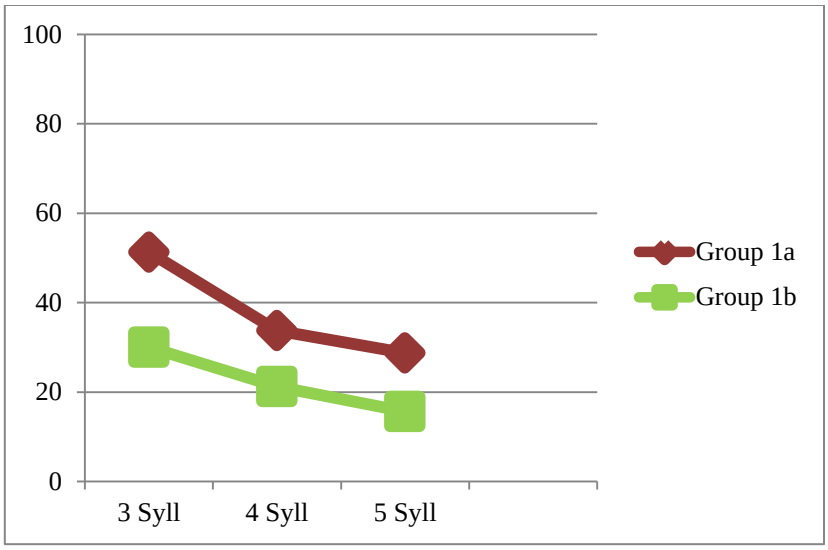

*Figure 4.10.*Mean percentage scores of Group 1a and Group 1b for immediate recall of words with different complexity.

Table 4.9

Performance of Group 1a and Group 1b for delayed recall of words (3 syllables vs. 4 syllables vs. 5 syllables)

Task	Group1a			Group1b		
	Mean	SD	Median	Mean	SD	Median
3 SYL	5	0.70	5	2.8	2.94	3
4 SYL	3.4	2.4	4	1.2	1.78	0
5 SYL	2.8	2.28	2	1	2.23	0

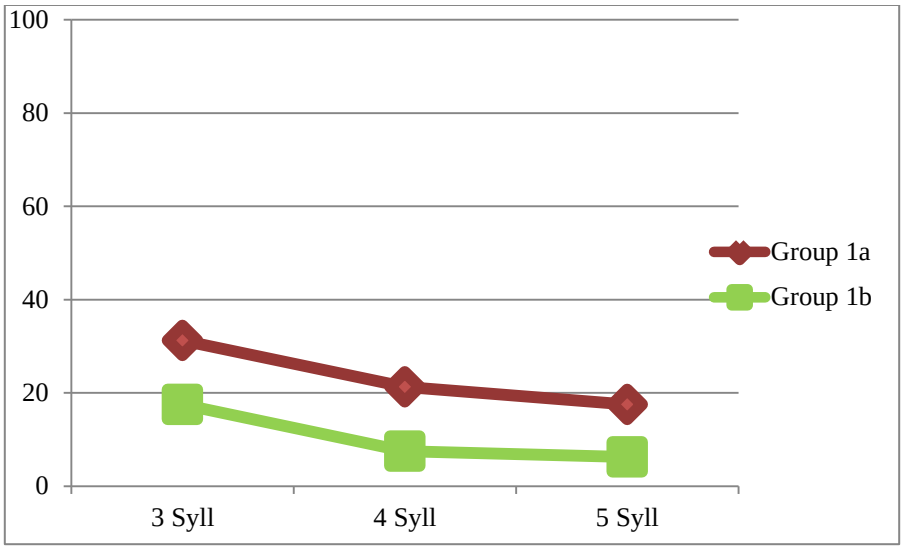

*Figure 4.11.*Mean percentage scores of Group 1a and Group 1b for delayed recall of words with different complexity.

On comparing the mean scores of group 1a and group 1b, it was seen that group 1a has scored higher in both immediate and delayed recall of 3 syllable, 4 syllable and 5 syllable words. But on Mann Whitney U test, it was revealed that the difference in scores between group 1a and group 1b was not statistically significant on both immediate recall of 3 syllable $|Z|=1.471$, $p>0.05$, 4 syllable $|Z|=1.174$, $p>0.05$ and 5 syllable words $|Z|=1.163$, $p>0.05$ and delayed recall of 3 syllable $|Z|=1.490$, $p>0.05$, 4 syllable $|Z|=1.519$, $p>0.05$ and 5 syllable words $|Z|=1.453$, $p>0.05$.

It can also be noticed from the above findings that performance has decreased with increase in complexity of words in both the groups. Further non-parametric Friedman's test was used to see if there was any significant difference in performance within the group 1a for words with different complexity (3 syllables, 4 syllables and 5 syllables). The results revealed that there was no significant difference obtained within 3 syllable, 4 syllable and 5 syllable words in

group 1a for both immediate [χ^2 (2) = 0.737, p>0.05] and delayed recall [χ^2 (2) = 3.125, p>0.05] of words. Similarly, non-parametric Friedman's test was also used to see if there was any significant difference in performance within the group 1b for words with different complexity (3 syllables, 4 syllables and 5 syllables). The results revealed that there was no significant difference obtained within 3 syllable, 4 syllable and 5 syllable words in group 1b for both immediate [χ^2 (2) = 3.818, p>0.05] and delayed recall [χ^2 (2) = 2.364, p>0.05] of words. Hence within both group 1a and group 1b, word complexity has no effect on the performance of immediate and delayed recall of words.

In the same lines, the mean, standard deviation (SD) and median were calculated for the performance of Group 1a (MCI) and Group 1b (Dementia) for immediate and delayed recall of semantically related and semantically unrelated words. Details are depicted below.

Table 4.10

Performance of Group 1a and Group 1b for immediate recall of semantically related and semantically unrelated words.

Task	Group1a			Group1b		
	Mean	SD	Median	Mean	SD	Median
SR	8.6	5.31	9	7.4	5.02	9
SUR	7	1.22	7	3.4	2.19	4

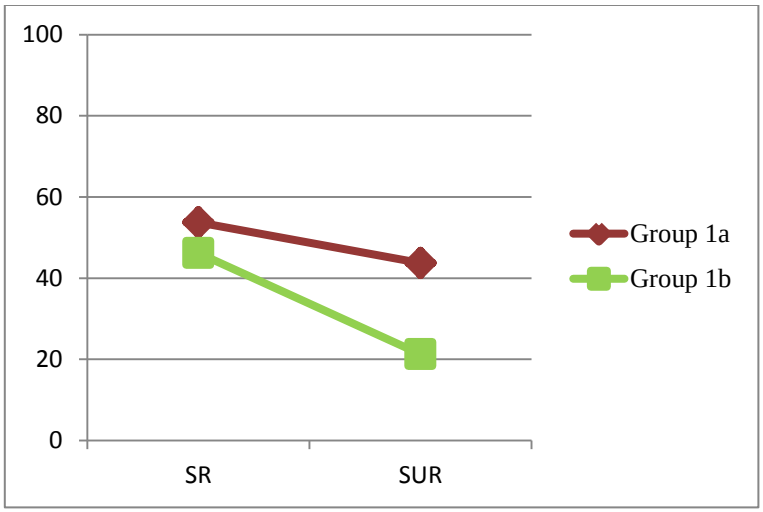

*Figure 4.12.*Mean percentage scores of Group 1a and Group 1b for immediate recall of semantically related and semantically unrelated words.

Table 4.11

Performance of Group 1a and Group 1b for delayed recall of semantically related and semantically unrelated words.

Task	Group1a			Group1b		
	Mean	SD	Median	Mean	SD	Median
SR	6.8	2.16	8	4	4.24	4
SUR	4.4	1.51	4	1.4	1.67	1

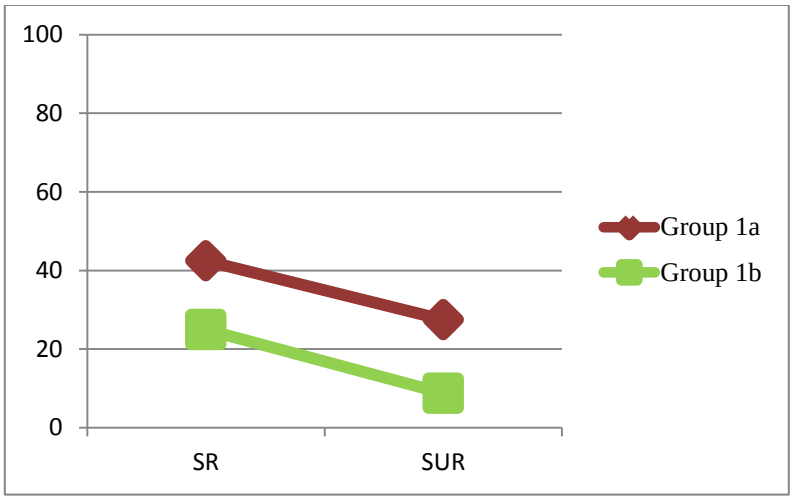

Figure 4.13. Mean percentage scores of Group 1a and Group 1b for delayed recall of semantically related and semantically unrelated words.

The performance in the table 4.9, 4.10 revealed that group 1a has performed superior to group 1b on both immediate and delayed recall of semantically related and semantically unrelated words. But Man Whitney U test revealed no significant difference between group1a on both immediate recall of semantically related $|Z|= 0.319$, $p>0.05$ and semantically unrelated words $|Z|= 2.424$, $p>0.05$. Similar results were obtained for group1a and group1b for delayed recall of semantically related $|Z|=1.054$, $p>0.05$ and semantically unrelated words $|Z|=2.115$, $p>0.05$.

From the above findings, it can also be noticed that performance has decreased for recall of semantically unrelated words than for recall of semantically related words in both the groups. Further non parametric Wilcoxon Signed rank test was used to see whether there was any significant difference in the performance between immediate recall of semantically related and semantically unrelated words and also between delayed recall of semantically related and semantically unrelated words within group 1a. It revealed that, the performance between

immediate recall of semantically related and semantically unrelated words did not show any statistical difference within group 1a. i.e immediate recall of semantically related and semantically unrelated words $|Z|=0.674$, $p>0.05$. Similarly, the performance between delayed recall of semantically related and semantically unrelated words also did not show any statistical difference within group 1. i.e delayed recall of semantically related and semantically unrelated words $|Z|=1.841$, $p>0.05$.

Non parametric Wilcoxon Signed rank test was used to verify whether there was any significant difference in the performance between immediate recall of semantically related and semantically unrelated words and between delayed recall of semantically related and semantically unrelated words within group 2 also. It revealed that, the performance between immediate recall of semantically related and semantically unrelated words did not show statistical difference within group 1b. i.e immediate recall of semantically related and semantically unrelated words $|Z|=1.826$, $p>0.05$. Similarly, the performance between delayed recall of semantically related and semantically unrelated words also did not show any statistical difference within group 1b. i.e delayed recall of semantically related and semantically unrelated words $|Z|=1.633$, $p>0.05$.

In the same lines, the mean, standard deviation (SD) and median were calculated for the performance of Group 1a (MCI) and Group 1b (Dementia) for immediate and delayed recall of non-words. Details are depicted below.

Table 4.12

Performance of Group 1a and Group 1b for immediate and delayed recall of non-words.

Task		Group1a			Group1b		
		Mean	SD	Median	Mean	SD	Median
Non-words	Immediate recall	0.8	1.3	0	4	0.89	0
	Delayed recall	0.2	0.44	0	0	0	0

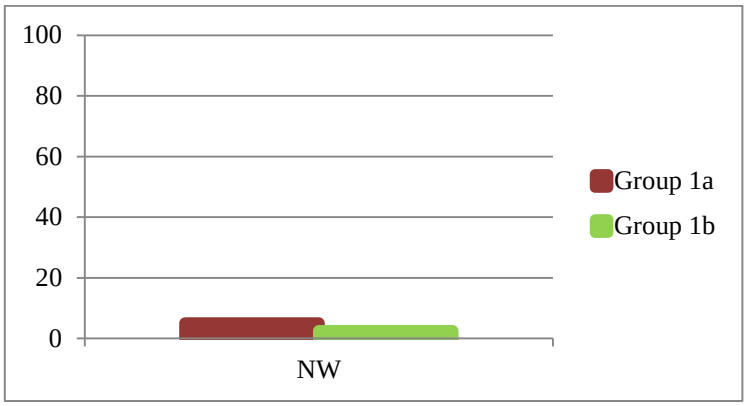

*Figure 4.14.*Mean percentage scores of Group 1a and group 1b for immediate recall of non-words.

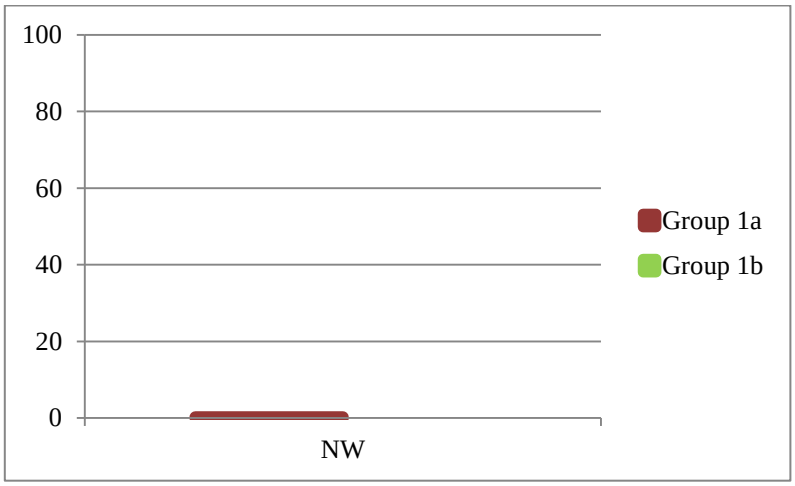

*Figure 4.15.*Mean percentage scores of Group 1a and Group 1b for delayed recall of non-words.

By comparing the mean scores of group1a and group1b, though it was noticed that both the groups have performed equally poorer on both immediate and delayed recall of non-words task, group 1a has scored slightly higher than that of group 1b on both immediate and delayed recall of non-words. Man Whitney U test revealed that there was no significant difference between immediate recall of non-words $|Z|= 0.643$, $p>0.05$. Similar result was obtained for between both the groups for delayed recall of non-words $|Z|=1.000$, $p>0.05$as well.

From the above findings, it can be noticed that the performance in both immediate and delayed recall of non-words is significantly reduced in both the groups. In order to see whether there was any difference in performance between immediate recall of words (4 syllable words) and non-words and between delayed recall of words (4 syllable words) and non-words within group 1a, non- parametric Wilcoxon Signed rank test was used. The results revealed that, the performance between immediate recall of immediate recall of words (4 syllable words) and non-words showed statistical difference within group 1a. i.e immediate recall of semantically related and semantically unrelated words $|Z|=2.032$, $p<0.05$ within group 1a. However, the performance between delayed recall of words (4 syllable words) and non-words did not show statistical difference within group 1a. i.e delayed recall of words (4 syllable words) and non-words $|Z|= 1.841$, $p>0.05$.

Similarly, in order to objectively verify whether there was any difference in performance between immediate recall of words (4 syllable words) and non-words and between delayed

recall of words (4 syllable words) and non-words within group 1b, non- parametric Wilcoxon Signed rank test was used. The results revealed that, there was no statistically significant difference for the performance between immediate recall of words (4 syllable words) and non-words within group 1b. i.e immediate recall of semantically related and semantically unrelated words |Z|= 1.633, p>0.05 within group 1b. Likewise, the performance between delayed recall of words (4 syllable words) and non-words also did not show any statistical difference within group 1b. i.e delayed recall of words (4 syllable words) and non-words |Z|= 1.342, p>0.05.

Objectives 3 and 4 aimed at exploring the performance between the individuals with MCI and Dementia for immediate and delayed recall of digits and words respectively. The results indicated that the individuals with MCI have performed superior to individuals with Dementia on all the tasks considered. However, statistically significant differences were not obtained for the performance between these individuals. MoCA which was used to screen for the inclusion criteria revealed scores ranging 13 to 21 for the participants with Dementia and from 22 to 24 for the participants with MCI. As it can be observed, the difference in scores obtained on MoCA for individuals with Dementia and MCI was very minimal. From this it can be inferred that the participants with dementia were in their early stages of cognitive decline and exhibited milder form of dementia. They most likely had overlapping features of cognitive impairment with that of participants with MCI. This may be a contributing factor responsible for not obtaining significant differences in any of the tasks between the participants with MCI and Dementia.

B) Qualitative Analysis

Recency and Primacy effect during recall and error analysis during recall in individuals with cognitive impairment.

Recency effect is where items presented at the end of the list may be recalled well at the beginning of recall whereas the primacy effect is the other way round. Qualitative analysis of the data obtained from participants with cognitive impairment was carried out. It revealed that these individuals showed greater tendency to recall last three or four items in the list initially when they performed immediate recall of digits and words. This indicated that, in these individuals, the recency effect was salient in immediate recall condition. However, in delayed recall of digits and words the recency effect reduced and the primacy effect was salient.

Recency effect is related to temporal context: if immediately tested, the present temporal context might serve as a retrieval cue. This would in turn predict more recent items to have an increased likelihood of recall, in contrast to items earlier in the list as these were studied in an altogether different temporal context (Howard & Kahana, 2002). The recency effect reduced for the delayed recall task because the delay cancelled out the recency effect. Also in the present study during the delay participants were asked to recite numbers and alphabets verbally aloud to prevent rehearsal. This could also have been a reason for reduced recency effect in delayed recall (Glanzer & Cunitz, 1966). Few of the studies report similar trend in the performance on recall by neurologically healthy older adults also. A study by Veena and Abhishek, 2016, reported that younger and older neurologically healthy adults also showed greater tendency to recall the last two to three items in the list initially on immediate verbal

recall of digits and words. However, this recency effect reduced on the delayed recall of digits and words in these individuals.

Further, the qualitative analysis also indicated that the participants had omission, transposition, repetition and intrusion errors during verbal recall. Intrusion errors in these participants can be due to their lack of inhibition where irrelevant information is brought to awareness while attempting to recall. Transposition errors were also seen in addition to intrusion errors, which show the inability of older individuals in maintaining the correct order of information (Cabeza et al., 2000). Repetition errors observed might be due to atrophy in frontal lobe and medial temporal lobes.

In a nutshell, the results of the present study revealed that there was a significantly poor performance in verbal recall in individuals with cognitive impairment compared to neurologically healthy individuals. Thus it can be inferred that the presence of cognitive impairment has hampered the performance on recall in these individuals.

Some of the previous studies had reported lexicality effect in verbal recall in individuals. The present study also has obtained similar results. The performance was better for words than non-words, shorter words (3 syllables) than for longer words (5 syllables) in both individuals with cognitive impairment and neurologically healthy individuals. Also, the performance was superior for recall of semantically related words compared to semantically unrelated words in these individuals.

Further, subgroups (MCI and Dementia) were made under the group of participants with cognitive impairment. Though participants with MCI scored much better compared to individuals with dementia, statistically significant differences were not obtained. This may be due to the fact that most of the participants in Dementia group had milder form of cognitive deficits and the quantum of cognitive impairment exhibited by these individuals might be the same which resulted in overlapping results on recall.

In the same lines, the results on qualitative analysis of the data revealed that the individuals with cognitive impairment showed greater recency effect on verbal recall of both digits and words in immediate recall condition. However, the recency effect reduced on delayed recall of digits and words. From this it can be inferred that these individuals can retain and retrieve the last items in the list better than the other items. Also, they had intrusion, omission, repetition and transposition errors during verbal recall which indicate the difficulty in accurately recalling the items in a list in these individuals.

Chapter 5

Summary and Conclusion

Cognition refers to a set of mental activities that are involved in processing of memory, language learning and speech. Learning about different cognitive processes helps us to understand how we acquire, store, retrieve and utilize knowledge (Matlin, 1983). Memory is a pivotal aspect of cognition. Until recently, memory has been studied only as a whole; hardly few attempts are made to explore the substrate of memory process like recall and recognition.

Long term memory has the traces of a lot of information of different types and hence recollecting this information is highly challenging. One of the major variables which would influence recall abilities is aging. The major trouble in older adults is the experience of memory loss and attention disturbances. The other difficulties include trouble in remembering in remembering activities of daily living, location of certain important objects also. However, the nature of memory loss is different in normal aging from that of memory loss associated with a diagnosis of any type of cognitive impairment, which is termed as cognitive impairment due to pathological aging.

Verbal recall is one of the strong indicators for early diagnosis of neuro-degenerative conditions such as Mild Cognitive Impairment and Dementia. Hence, understanding verbal recall abilities is very important and especially in Indian context where studies explicitly focusing on recall are limited. Previous research studies have focussed on experiments based

on learning and retention, but the nature of stored material, its structure and its effect on recall has not been explored to a greater extent.

The purpose of the present study was to explore verbal recall abilities in persons with cognitive impairment due to neuro-degeneration and neurologically healthy individuals (paired matches) on immediate and delayed verbal recall for digits and words. 10 neurologically healthy individuals and 10 individuals with cognitive impairment were recruited for the study. These participants were further grouped based on the nature of cognitive impairment (MCI and Dementia) The selection of participants was based on Montreal Cognitive assessment (MoCA), by Nasreddine, Bédirian, Charbonneau, Whitehead, Collin, Cummings & Chertkow, (2005). All the participants considered were above 50 years of age with Kannada as their native language.

The test protocol used in the Dissertation, 'Verbal recall abilities in younger and older adults' (Veena & Abhishek, 2016) served as the stimulus for the study. The stimulus consisted of 2 lists of 3 syllable, 4 syllable and 5 syllable words (Ranganath, 1983), a list of semantically related and unrelated items (Abhishek & Prema, 2014), digit recall list (Aruna & Prema, 2001) and a set of nonwords (Shylaja & Swapna, 2010). Each list had 8 items, which was presented across the 2 conditions i.e., immediate recall and delayed recall. The tasks were 3 syllable, 4 syllable and 5 syllable word recall, semantically related word recall, semantically unrelated word recall, digit recall and non - word recall. The stimuli were played to participants through headphones. The responses of the participants were audio recorded using Voice Recorder. The obtained data was analysed both quantitatively and qualitatively.

The primary objective of the study was to investigate the performance between individuals with cognitive impairment and paired matches for immediate and delayed recall of digits. Mean and median values were more for neurologically healthy individuals compared to individuals with cognitive impairment and a statistically significant difference was seen on Mann-Whitney U test. It can be inferred from the results that verbal recall abilities differed significantly between the groups (participants with cognitive impairment and neurologically healthy individuals) for immediate and delayed recall of digits.

The second objective was to compare the performance between persons with cognitive impairment and paired matches for immediate and delayed recall of word list. The word list included words of different syllable length (3,4 and 5 syllables), semantically related words, semantically unrelated words and non -words. Mean and median scores were higher for neurologically healthy individuals compared to individuals with cognitive impairment for both immediate and delayed recall of words. Mann-Whitney U test was used to compare the performance between the groups. It revealed significant difference between the two groups on both immediate and delayed recall of words except for 3 syllable word immediate recall. Results also indicated that recall abilities differed according to the nature of stored material and its structure. It was observed that as the length of the word increased from 3 syllables to 5 syllables, the recall abilities drastically decreased which shows the effect of word length on recall in neurologically healthy individuals. But in individuals with cognitive impairment, performance did not vary as a function of syllable length. Through the findings it can be inferred that individuals with cognitive impairment have significant difficulties in verbal recall of both simple and complex words.

Further, the performance of neurologically healthy individuals and persons with cognitive impairment was compared for semantically related and unrelated words and non-words on immediate and delayed recall of. Individuals with cognitive impairment performed poorly compared to neurologically healthy individuals on all the three tasks. Man Whitney U test revealed significant difference in performance of immediate and delayed recall of semantically related and unrelated words between the groups. Scores on semantically related words was better compared semantically unrelated words in both the groups. Performance was better for semantically related words compared to unrelated words. This in consonance with the findings of Saint- Aubin& Poirier, 1999. The reason quoted in defence is that the semantically related words would trigger the long term memory. Considering the performance of recall of non-words between groups, statistical significant difference was obtained for delayed recall of non-words but not for immediate recall of non-words. Performances of non-word recall was poorer compared to that of words. This can be attributed to the phonological encoding deficits in individuals with cognitive impairment (Schweikert, 1993).

The third objective of the study was to compare the performance between individuals with MCI and Dementia for immediate and delayed recall of digits. Upon comparing the performance of both the groups, it was noted. However Man-Whitney U test did not reveal any statistical significance for the performance between the groups for immediate and delayed recall of digits. This may be because dementia group mostly comprised of individuals with mild degree of dementia whose characteristic features and severity of memory impairment usually overlaps with that of MCI individuals.

The fourth objective was to compare the performance between persons with MCI and Dementia for immediate and delayed recall of word list. The word list included words of different syllable length, semantically related words, semantically unrelated words and non -words. Mean and median scores were higher for individuals with MCI than individuals Dementia in all the tasks i.e. for words of different syllable length, semantically related words, semantically unrelated words and non -words. Man Whitney U test did not reveal statistically significant difference for all the tasks between the groups. This again can be attributed to the mild quantum of cognitive linguistic deficits in persons with dementia which may in par with the cognitive linguistic deficits exhibited by persons with MCI.

Thus, the study enables the understanding of the notion that along with other cognitive processes recall abilities also declines with increasing age but the extent of decline may be more rapid in presence of pathological aging (neuro-degeneration). Individuals with cognitive impairment may confront significant memory disturbances especially with respect recall/ retrieval. These recall abilities also vary with respect to the nature of the linguistic stimulus. This further supports the notion that language and memory are intricately connected.

Implications of the study:

The current study investigated recall abilities in persons with cognitive impairment. It was noted that persons with cognitive impairment performed poorly compared to neurologically healthy individuals who were age matched

It enables the relationship between linguistically loaded stimuli and recall abilities in individuals with cognitive impairment.

Findings obtained from the study may also have significant effects in planning appropriate assessment and treatment strategies in persons with cognitive linguistic deficits secondary to neuro-degeneration.

Limitation

Data collection was carried out on a small group of participants which prevents the generalization of the obtained findings apart from the this there were no overt nuances in the study.

Future directions

- The study can be carried out on a larger population to generalise the findings.
- Different variants of dementia like vascular, Alzheimer's disease etc can be considered
- In order to trace the pattern of performance over time, recall abilities can be tested again after a lapse of 6 months

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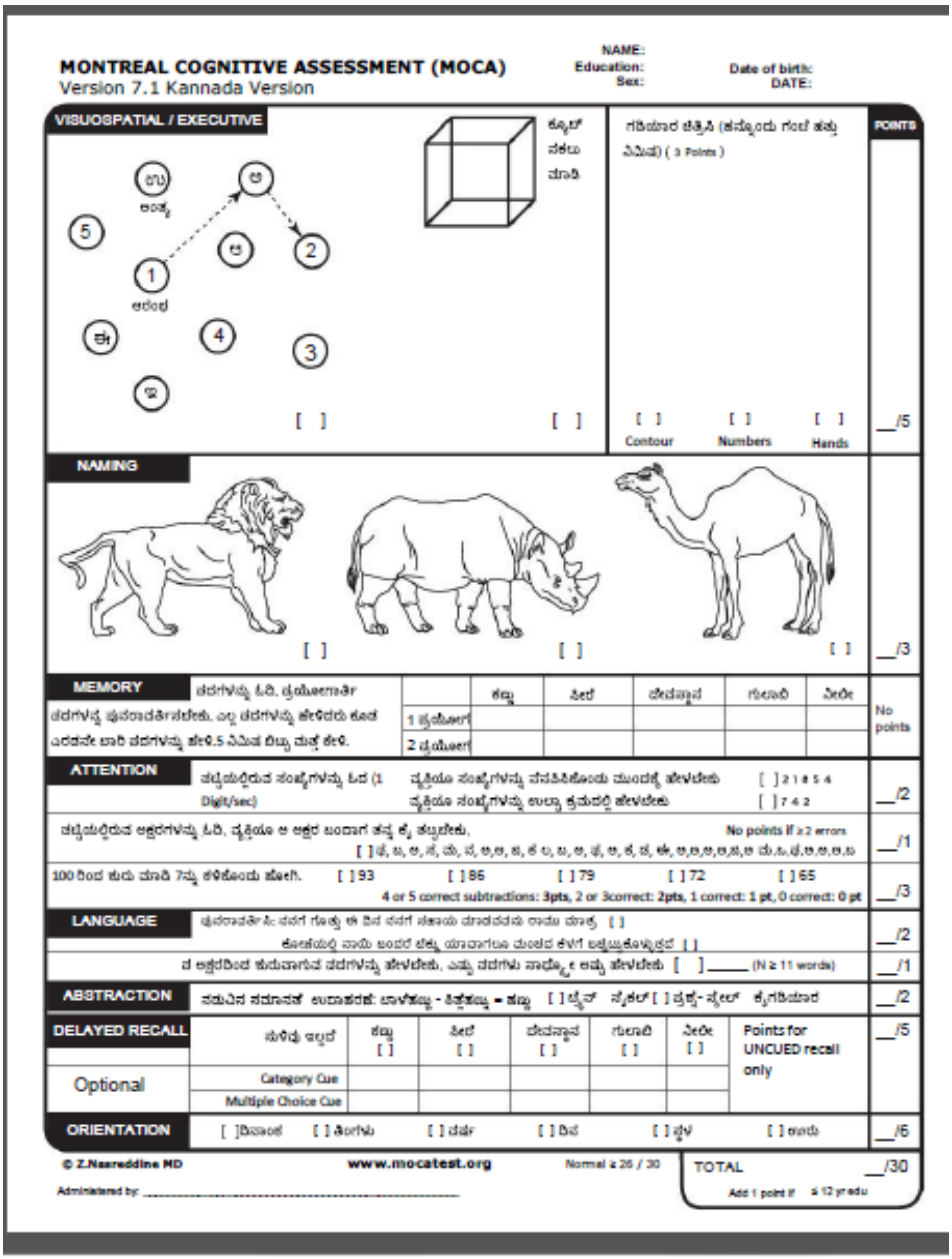
Appendix-1

Screening Assessment tool used for the study: Montreal Assessment Scale (MoCA)- Kannada Version



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Kannada Version

NAME:
Education:
Sex:
Date of birth:
DATE:

VISUOSPATIAL / EXECUTIVE — POINTS

ಕ್ಯೂಬ್ ನಕಲು ಮಾಡಿ

ಗಡಿಯಾರ ಚಿತ್ರಿಸಿ (ಹನ್ನೊಂದು ಗಂಟೆ ಹತ್ತು ನಿಮಿಷ) (3 Points)

[ ] Contour [ ] Numbers [ ] Hands __/5

NAMING __/3

[ ] [ ] [ ]

MEMORY ಪದಗಳನ್ನು ಓದಿ, ಧ್ವನಿಯಾಗಿರಿ

ಪದಗಳನ್ನ ಪುನರಾವರ್ತಿಸಬೇಡಿ. ಒಮ್ಮೆ ಪದಗಳನ್ನು ಹೇಳಿದರು ಕೂಡ ಎರಡನೇ ಬಾರಿ ಪದಗಳನ್ನು ಹೇ.5 ನಿಮಿಷ ಬಿಟ್ಟು ಮತ್ತೆ ಕೇ.

	ಕಟ್ಟು	ಕೆಂಪು	ದೇವನಾಗರಿ	ಗುಲಾಬಿ	ನೀಲಿ
1 ಧ್ವನಿಯ					
2 ಧ್ವನಿಯ					

No points

ATTENTION __/2

ಪದ್ಯಭಿರಿಯ ಸಂಖ್ಯೆಗಳನ್ನು ಓದ (1 Digit/sec) — ವ್ಯತಿಯೂ ಸಂಖ್ಯೆಗಳನ್ನು ನೆನಪಿಸಿಕೊಂಡು ಮುಂದಕ್ಕೆ ಹೇಳಬೇಕು [ ] 2 1 8 5 4

ವ್ಯತಿಯೂ ಸಂಖ್ಯೆಗಳನ್ನು ಉಲ್ಟಾ ಕ್ರಮದಲ್ಲಿ ಹೇಳಬೇಕು [ ] 7 4 2

ಪದ್ಯಭಿರಿಯ ಅಕ್ಷರಗಳನ್ನು ಓದಿ. ವ್ಯತಿಯೂ ಅ ಅಕ್ಷರ ಬಂದಾಗ ತನ್ನ ಕೈ ತಟ್ಟಬೇಕು. No points if ≥ 2 errors __/1

[ ] ಫ, ಬ, ಅ, ಸ, ಮಿ, ಪ, ಅ,ಅ, ಪ, ಕ ಬ, ಬ, ಅ, ಫ, ಅ, ಕ, ಪ, ಈ, ಅ,ಅ,ಅ,ಅ,ಪ,ಅ ಮ.ಸ.ಫ.ಅ.ಅ.ಬ

100 ರಿಂದ ಕುರು ಮಾಡಿ 7ನ್ನು ಕಳಿಕೊಂದು ಹೋಗಿ. [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65 __/3

4 or 5 correct subtractions: 3pts, 2 or 3correct: 2pts, 1 correct: 1 pt, 0 correct: 0 pt

LANGUAGE __/2

ಪುನರಾವರ್ತಿಸಿ: ಪದಗೆ ಗೂಳ್ಳ ಈ ರಿಂದ ಪದಗೆ ಚಚಾಯ ಮಾಂಡವರಿಯ ರಾಮು ಮಾಕ್ರ [ ]

ಕೋಕಯಲ್ಲಿ ಬಾಯಿ ಬಂದರೆ ಬೆಳ್ಳು ಯಾವಾಗಲೂ ಮುಂಚಿತ ಕೆಳಗೆ ಅಪ್ಪುಕೊಳ್ಳುತ್ತದೆ [ ]

__/1

ಆ ಅಕ್ಷರದಿಂದ ಶುರುವಾಗುವ ಪದಗಳನ್ನು ಹೇಳಬೇಕು. ಎಷ್ಟು ಪದಗಳು ಸಾಧ್ಯೋ ಅಷ್ಟು ಹೇಳಬೇಕು [ ] _____ (N ≥ 11 words)

ABSTRACTION ಸದುವಿನ ಸದೂನತೆ ಉದಾಹರಣೆ: ಬಾಳೆಹಣ್ಣು - ಕಿತ್ತಳೆಹಣ್ಣು = ಹಣ್ಣು [ ] ಟ್ರೈನ್ ಸೈಕಲ್ [ ] ಪ್ಯಾಂಟ್ - ಸ್ಕರ್ಟ್ ಕೈಗಡಿಯಾರ __/2

DELAYED RECALL __/5

	ಸುರಿಪು ಇಲ್ಲದೆ	ಕಟ್ಟು [ ]	ಕೆಂಪೆ [ ]	ದೇವನಾಗರಿ [ ]	ಗುಲಾಬಿ [ ]	ನೀಲಿ [ ]	Points for UNCUED recall only
Optional	Category Cue						
	Multiple Choice Cue						

ORIENTATION [ ]ದಿನಾಂಕ [ ] ತಿಂಗಳು [ ] ವರ್ಷ [ ] ದಿನ [ ] ಸ್ಥಳ [ ] ನಗರ __/6

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TOTAL __/30

Add 1 point if ≤ 12 yr edu

Administered by: _____

Stimulus Materials used for tasks

Test Items-List 1:

3 Syllable words	4 Syllable words	5 Syllable words
agala	guruva:ra	utpa:daneya
ananta	ka:rmikaru	chathuratike
uthsava	namaska:ra	dehaliyalli
janata	tatvagaLu	hogaLuvante
tamage	madyavarti	rasamayate
daniya	manadaTTu	pratibhaTane
taya:ru	devasta:na	naDeyisalu
prasa:ra	garagasa	varadhiyannu

Test Items-List 1:

Semantically related words	**Semantically unrelated words**	**Digits**	**Non-words**
simha	ka:Du	mu:ru	naluvi
huli	huNNime	enTu	vabhanura
chirate	so:ma:ri	a:ru	luTTilugama
katte	muLLu	e:Lu	Tabaluniga
karaDi	haLadi	eraDu	giladema
ha:vu	rakta	aidu	niva:shara
na:yi	kannaDi	e:Lu	labata
ko:ti	ko:ti	mu:ru	yellinema

Test Items-List 2:

3 Syllable words	4 Syllable words	5 Syllable words
ba:gilu	adhika:ri	nagunaguta
mamate	pativrate	muttugaLannu
de:varu	bi:saNige	ra:gagaLige
janani	manastiti	modalaneya
tabala	tarabe:ti	nischintana:gi
gamana	shivalinga	kuduregaLu
kannaDa	oLagaDe	maraLuga:Du
jami:nu	managonDa	vruttipararu

Test Items-List 2:

Semantically related words	**Semantically unrelated words**	**Digits**	**Non-words**
taTTe	o:le	sonne	garasaga
lo:Ta	yantra	ondu	le:ttaka
gaDiya:ra	sa:mba:ru	mu:ru	maluvigana
bi:saNige	raste	ombhatu	tipa:cha
ba:gilu	maDike	e:Lu	malunega
kiTaki	kattari	a:ru	gareLukudu
pustaka	ga:Li	enTu	shane:ga
le:Khani	hullu	na:lku	sabava