Chapter 2

Review of Literature

2.1 Normal Aging

2.1.1 Neuroanatomy and neurophysiology of typically aging individuals.

2.1.1.1 Dendrite and dentritic spine changes during aging.
2.1.1.2 Volumetric changes in healthy aging brain.
2.1.1.3 Thinning of the cerebral cortex in aging.

2.2 Dementia

2.2.1 Classification of dementia
2.2.2 Neuroanatomy of dementia.
2.2.2.1 Pathological hallmark of dementias.

2.3 Cognitive processes in aging.

2.4 Cognitive Processes in mild Dementia

2.4.1 Memory deficits in dementia.

2.4.1.1 Deficits in Episodic memory (EM) in dementia.
2.4.1.2 Deficits in Semantic memory (SM) in dementia.
2.4.1.3 Deficits in Executive Function (EF) in dementia.

2.4.2 Attention and concentration in early stage of dementia.

2.4.3 Abstraction and problem solving processes in dementia.

2.4.4 Visuospatial abilities in persons with dementia.

2.5 Linguistic skills during healthy aging

2.5.1 Aging and language processing.
2.5.2 Aging and understanding language.
2.5.3 Aging and spoken language.

2.6 Cognitive decline, communication and dementia

2.7 Linguistic skills and deficits in Dementia

2.7.1 Syntactic comprehension deficits.
2.7.2 Word finding difficulties.
2.7.3 Auditory comprehension in dementia.
2.7.4 Reading comprehension in dementia.
2.7.5 Conversational abilities in persons with dementia.

2.7.5.1 Turn taking.
2.7.5.2 Topic shifts.
2.7.5.3 Information content.
2.7.5.4 Communication Intent.
2.7.5.5 Information adequacy.
2.7.5.6 Repair strategies.
2.7.5.7 Deficits of Cohesion.
2.7.5.8 Coherence.
2.7.5.9 Linguistic non-fluency.

2.7.6 Studies on T-unit based analysis.

2.7.7 Studies on measures of richness of vocabulary.

2.8 Bilingual language production.

2.8.1 Neurolinguistics of bilingualism.

2.9 Dementia and Bilingualism.

2.10 Indian studies on dementia.
Chapter 2

Review of Literature

According to an official world health organization (WHO) press release in 1993, India has the second largest population of the world’s elderly. They constituted only 24 million in 1961 and it increased to 57 million in 1981, and 77 million in 2001. The census report by Irudaya (2006) has shown that these elderly accounted for 96 million by 2011 in India. This dramatic rise in the number of elderly persons is due to the accelerating rate of growth of the human population and due to constantly improving health care facilities. This has accounted for the longevity of human life. Due to this change it is indeed time to pay greater attention to the unique problems that the geriatric population faces.

2.1 Normal Aging

Aging is a complex process composed of several features. It is an exponential increase in mortality with age, physiological changes that typically lead to a functional decline with age and increased susceptibility to certain diseases with age. “By definition, aging is a progressive deterioration of physiological function, an intrinsic age-related process of loss of viability and increase in vulnerability” (Hayflick, 1994). Elderly people are at greater risk of neurologic disease than young people. The diagnosis of disease in elderly is often complicated because of the alterations in brain structure and function that may occur normally. Understanding the course of normal brain development during aging provides the foundation for the identification of pathologic brain development and decline. These changes (which occur) due to aging are observed in brain and related structures using many imaging studies.

2.1.1 Neuroanatomy and neurophysiology of typically aging individuals.

In brain, neurons have significant homeostatic control of essential brain function. Although there is no overt loss of neurons during normal aging, other, more subtle, changes occur in individual neurons. These include shrinkage in soma size, loss or regression of dendrites and dendritic spines, alterations in neurotransmitter receptor, and changes in electrophysiological properties (Nakamura et al., 1998; Jacobs, et al., 2001).
Qualitative magnetic resonance (MR) imaging studies have provided information about neural density on a number of specific brain structures like cerebrum, corpus callosum, cerebellum, brainstem, hippocampus (Baumgardner et al., 1996; Berquin, et al., 1998).

2.1.1.1 Dendrite and dendritic spine changes during aging.

It is known that cognitive abilities are impaired during normal aging. This cognitive decline is known to be accompanied by subtle changes in neuronal morphology (Morrison & Hof, 2002). Many studies have demonstrated minimal neuronal loss in cortical and hippocampal regions during normal aging (West, Coleman, Flood, & Troncoso, 1994; West, Kawas, Stewart, Rudow, & Troncoso, 2004; Morrison & Hof, 2002). They suggest that the age-related impairments that occur during normal aging are due to distinct processes. In the absence of neuronal degeneration, irregularities in dendritic arborization and in spine length or volume, distribution, number, or morphology can have detrimental effects. Many studies have also demonstrated age-related regression in the dendritic arbors and the dendritic spines of pyramidal neurons located in the prefrontal, superior temporal and precentral cortices in humans (Scheibel, Lindsay, Tomiyasu, & Scheibel, 1975; Kramers, & Uylings, 1998).

2.1.1.2 Volumetric changes in healthy aging brain.

The volumetric changes in brain includes alterations in intracranial spaces, whole brain volumes, gray matter (GM) volume, white matter (WM) volume, GM-WM ratio, and intracranial craniospinal fluid (CSF) volume. Age-related changes in intracranial space are observed and intracranial space volume grows exponentially by 27% between early childhood and early adolescence. Across all ages, intracranial space volumes will be between 10% smaller in female than in males. Whole brain volume grows exponentially by 25% between early childhood and adolescence. Age related change in GM is seen and GM increases by 13% from early childhood to later childhood. Thereafter, it decreases linearly by approximately 5% per decade throughout life. WM increases by 74% from early childhood to adolescence. A variety of neuropathologic, CT, and MR imaging studies suggest that 30%-80% of elderly individuals without neurologic deficits have
focal abnormalities in the cerebral white matter (Tomlison, Blesed, & Roth, 1968; Bradely, Waluch, & Brant-ZawadZki, Yadley, & Wyeoff, 1984).

A mild-to-moderate progressive enlargement of the ventricle, cortical sulci, and pericerebellar subarachnoid spaces may occur with aging (Davis & Wright, 1977; Dekaban & Sadowsky, 1978; Creasey & Rapoport, 1985). Cortical atrophy is most prominent in the frontal and parietal parasagittal regions and moderate ventricular enlargement is associated with infarction of the basal ganglia. Total ventricular and extracerebral CSF volume increases during the life span. The total volume of CSF is more than double between early childhood and middle adulthood. And this increase is linear for males and females. Between early childhood and early adolescence, the healthy brain and intracranial space grow exponentially by about 25-27%; however, by 71-80 years of age, brain volume is less than that of a 2-3 year old children (Tomlison, Blesed, & Roth, 1968; Bradely, Waluch, & Brant-ZawadZki, 1984; Farekas, Chawluk, & Alavi, 1987)

2.1.1.3 Thinning of the cerebral cortex in aging.

Many authors have reported a selective loss of neurons with age (Tomlison, Blesed, & Roth, 1968; Brody & Vijayshankar, 1977; Terry, DeTeresa, & Hansen, 1980; Huag, 1987; Anderson, Hubbard, Coghill, & Slidders, 1983). These changes are most prominent in the superior frontal and temporal gyri, precentral gyrus, corpus striatum, hippocampus, thalamus, amygdaloid body, inferior olive and Purkinje cells and denate nucleus of the cerebellum. A decrease in dendritic branching and possible loss of neuronal synapses in the temporal, frontal, and limbic regions of cerevrum also characterize normal aging (Huttenlocher, 1979).

Neuroimaging studies have confirmed that there are alterations in global brain morphologic properties due to aging (Jernigan, Trauner, Hesselink, & Tallal, 1991; Jernigan, et. al., 2001; Raz et al., 1997; Good et al., 2001; Sowell et al., 2003). These studies additionally support the view that morphological alterations may be accelerated in
particular areas of the cortex. Raz (2000) define these changes as a ‘patchwork pattern of differential declines and relative preservation’. Preferential vulnerability of prefrontal cortex is greater than changes in other regions. Salat, Buckner, & Snyder et al., (2004) measured the thickness of the cerebral cortex from MR images as well as manual measurements to examine the regional patterns of age-associated cortical thinning. They found that age-related thinning was widespread and spanned to a number of cortical regions when thickness is regressed on aged individuals. Significant thinning is found in primary sensory (occipital lobe/calcarine), primary somatosensory and motor (pre/post central gyrus and central sulcus) and association cortices (inferior lateral prefrontal cortex), with greatest statistical significance in inferior prefrontal, precentral and supramarginal regions.

Apart from changes in the typically aging individuals there exist pathological changes in persons with dementia. These changes are different for different types of dementias and they vary in their degrees with respect to the stages of dementia. As this study is concentrated on three types of dementia viz DAT, vascular dementia and mixed dementia, the neuropathology of these dementias have been reviewed.

2.2 Dementia

2.2.1 Classification of dementia.

Dementia can be categorized into cortical dementias and sub-cortical dementias based on the part of the brain which is affected due to the disease.

Cortical dementias arise from a disorder affecting the cerebral cortex, the outer layers of the brain that play a critical role in cognitive processes such as memory and language. Alzheimer's and Creutzfeldt-Jakob disease are two forms of cortical dementia. Patients with cortical dementia typically show severe memory impairment and aphasia (the inability to recall words and understand common language). Sub-cortical dementias result from dysfunction in the parts of the brain that are beneath the cortex. Usually, memory loss and language difficulties that are characteristic of cortical dementias are not present in sub-cortical dementias. Rather, people with sub-cortical dementias, such as Huntington's disease, Parkinson's disease, and or HIV (human immunodeficiency virus)
disease dementia complex, tend to portray changes in their personality and attention span, and their thinking ability will slow down.

Another standard classification of dementia is given by The International Statistical Classification of Diseases and Related Health Problems of 10th Revision (ICD-10). It is a coding system of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO, 1992). The code set allows more than 155,000 different codes and permits tracking of many new diagnoses and procedures. Dementia falls into mental and behavior disorders category found in the fifth chapter. According to this, dementia is classified based on organic and symptomatic conditions. There are four types of dementia, on a broader classification. They are, dementia in Alzheimer's disease, vascular dementia (such as multi-infarct dementia, sub-cortical dementia and mixed type), dementia in other diseases (such as, Pick's disease, Creutzfeldt-Jakob disease, Huntington's disease, Parkinson's disease and human immunodeficiency virus or HIV disease) and unspecified dementia (usually associated with delusion, hallucination and depression).

Vascular dementia is one of the most common forms of dementia, ranking only second to Alzheimer’s disease. Vascular dementia is caused by chronic, reduced blood flow to the brain usually as the result of a stroke or series of strokes. Mixed dementia is a condition in which Alzheimer's disease and vascular dementia occur at the same time.
Table 2.1

Brief description of type, cause, site of lesion and characteristics for different types (most common) of dementing disease.

<table>
<thead>
<tr>
<th>Type of dementia</th>
<th>Definition</th>
<th>Causes</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cortical dementias</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-infarct dementia (MID)/vascular dementia</td>
<td>Group of heterogeneous dementing disorders due to cerebrovascular insufficiency.</td>
<td>Stroke, small vessel disease, or a mixture of the two.</td>
<td>difficulty in performing tasks such as balancing a checkbook, playing games (such as bridge), and learning new information or routines, getting lost on familiar routes, language problems, such as trouble in word-finding, and losing interest in things.</td>
</tr>
<tr>
<td>Fronto-temporal dementia</td>
<td>Degeneration of the frontal and temporal lobe.</td>
<td>Degeneration of the frontal lobe of the brain and may extend back to the temporal lobe.</td>
<td>Changes in personality, emotion, executive functions, special preoccupations, language, memory, perception and constructive abilities.</td>
</tr>
<tr>
<td><strong>Sub-cortical dementias</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkinson's disease Dementia</td>
<td>Progressive disorder of the central nervous system.</td>
<td>Degenerative disorder of the brain.</td>
<td>Depression, anxiety, personality and behavior changes sleep disturbances, and sexual problems.</td>
</tr>
<tr>
<td>Huntington disease dementia</td>
<td>Genetic, autosomal dominant, neurodegenerative disorder characterized clinically by disorders of movement.</td>
<td></td>
<td>Progressive dementia and psychiatric and/or behavioral disturbance.</td>
</tr>
</tbody>
</table>

Notes.

Cummings & Benson, 1983.
2.2.2 Neuroanatomy of dementia.

Dementia is a frequent consequence of neurodegeneration of cerebral cortex. The present study considered three types of dementias (DAT, vascular dementia and mixed dementia). The widespread changes in cortical structures and cognitive impairment in dementia is due to the disease which cause degeneration in the brain. But these diseases do not affect entire cerebral cortex but have different profiles of anatomic involvement based on the type of dementias. It is widely accepted that cognition is supported by distributed neural systems and that it is susceptible to dissociation by focal brain damage.

According to Grabowski and Damasio (2004) the syndrome of primary dementia reflects the relative sparing of primary motor and sensory cortex. Though dementia is considered to be global encephalopathy, neither the cognitive impairment nor the pathology is usually diffuse. A typical Alzheimer’s dementia will present with anterograde amnesia and visuospatial disorientation. Front-temporal dementias demonstrate relatively good anterograde memory and visuospatial orientation on formal test, but have insidious behavior disorder and defective social decision-making.

2.2.2.1 Pathological hallmark of dementias.

The major histopathological criteria for dementia are presence of neocortical, hippocampal and entorhinal neurofibrillary tangles, and neocortical neuritic plaques. The abnormal proteins present in AD are in senile plaques and cerebral blood vessels, and in neurofibrillary tangles.

The pathology of Alzheimer’s disease is characterized by the accumulation of insoluble fibrous material in intracellular and extracellular locations. The intracellular pathology consists of granulovascular change (GVC), hirano bodies and neurofibrillary tangles (NFTs). The extracellular deposits are senile plaques (Sps). GVC was originally described by Simchowicz in 1911. GVC manifest as small inclusions, 3-5µm in diameter. They are found in pyramidal neurons of hippocampus formation. Hirano bodies are eosinophillic, hyaline inclusion body present in hippocampal region. Neurfibrillary tangles are insoluble intracellular structures composed primarily of accumulations of paried 10nm helical filaments (Kidd, 1963). Senile plaques are second major
manifestation of AD. Accordign to Blocq and Marinesco (1928) senile plaques are local spherical deposits of fibrillary amyloid surrounded by dystrophic neuritis. Arnold, Trojanowski, Gur, Blackwell, Han, and Choi, (1998) survey of cerebral cortex revealed that NFTs are found in greatest number in limbic periallocortex (area 28). Also they have found the involvement of proiscortical temporal pole in AD.

Jellinger et al (1990) applied criteria for diagnosing vascular dementia; there should be one or more large cerebral infarcts, or extensive cortical granular atrophy, diffuse or multiple focal small infarcts, or lacunae in white matter and multiple small lesions or lacunae in the basal ganglia, or mixed cortical and subcortical vascular lesions. Tomlinson, Blessed, and Roth (1970) indicated that gross infarct volumes of greater than 100ml caused dementia, and infarct volumes between 50 and 100ml produced dementias less consistently in vascular type. A quantitative MRI study by Liu et al., (1992) comparing stroke patients with and without dementia demonstrated that total cerebral infarcted area cortical involvement were significantly larger in demented group.

In frontotemporal dementia there is fronto temporal lobe degeneration. It starts insidiously and develops slowly. The early stage is dominated by changes in personality, behavior and speech, and is less dominated by cognitive deterioration, but impaired memory functions are present. Single photo emission computed tomography (SPECT) and positron emission tomograpgy (PET) usually show diminished flow/ hypometbolism in frontal or frontotemporal reagions, and better preserved central and posterior cortical functions (Gustafson, et. al, 1998).

Zekry, Duyckaerts, Belmin, Geoffre, Herrmann, Moulias and Hauw (2003) used a volumetric study of the functional zones of human brain map affected by vascular lesions and correlations between quantified neuropathological data and the severity of dementia were performed in cases with large vascular lesions, pure AD, and both lesions. The severity of cognitive impairment was significantly correlated with the total volume of infarcts. The total volume of ischemic lesions explained only 0.1–5% of the variability in MMSE and GDS. Age only explained an extra of 0.1–1.6%. This study
confirms that infarcts located in strategic areas have a role in the mechanism of cognitive impairment and brings a key for their quantification.

Hence it is observed that there are neuroanatomical changes and neurophysiological changes in brain during typical aging and atypical aging or persons with dementia. These changes in healthy aging and persons with dementia can alter neurocognitive and neurolinguistic skills in the individuals. These skills include cognition, language, executive functions and so on.

2.3 Cognitive processes in aging.

Most basic cognitive processes decline with advanced age at higher levels of difficulty. Part of this reflects the slowing down that occurs with age. There is a reduction in processing capacity with age. The processes that are affected due to aging include, processes involving attention, working memory capabilities, understanding text, making inferences, encoding(putting information into memory) and retrieval (finding information in memory). There are other processes that show little or no decline with age. These include, picture recognition, implicit memory (information that can't be brought to mind but can be seen to affect behavior), prospective memory (remembering things you need to do) (Park & Denise, 1992).

Hence cognitive decline in old age may be primarily due to the reduction in processing capacity - understanding text, making inferences, paying attention are all processes that depend heavily on the working memory capability.

It has also been theorized that age-related cognitive decline may result primarily from the slowing down that occurs with age. But it seems likely that there is more involved than simply this, as age differences are still found on many tasks even when there is unlimited time to do them. It may well be that there is an interaction between slower processing and decreased capacity, causing the timing to be more critical in complex situations (e.g., approaching a complex traffic interchange on a freeway at relatively high speed) (Park, 1992). Practice does improve speed in older adults (though
not to the level that it does in younger adults). Another theory is that older adults develop problems with the inhibitory mechanisms in working memory (the part of our brain that enables us not to pay attention to irrelevancies), and it is this that gives the impression that there has been a decrease in processing resources (Park, 1992).

Speed of processing has received a large amount of attention and has been hypothesized as the major underlying mechanism for all cognitive deterioration. Although there are competing theories proposed in the literature, the processing-speed theory has been well developed and has received a considerable amount of empirical support (Glisky, 2007).

The use of language depends on cognitive components such as perception, attention, reasoning and memory. Memory is considered to be the core of cognition. It is prerequisite to the understanding of the cognitive processing involved in language production and comprehension. In using language one has to draw on the abilities to encode information, to store information over short or long periods of time, and to retrieve the information at the time of speaking. If older individuals have difficulty in one or more of these stages, it would be reflected as changes in their ability to use language, either as a listener or as a speaker (Smith & Fulleton, 1981). Hence age related changes also affect language abilities in elderly. It can encompass both comprehension and production abilities.

2.4 Cognitive Processes in mild Dementia

Cognitive decline is the hallmark of dementia. This decline varies across stages and sometimes across the types of dementia. The processes which are prone to decline include, memory, executive function, attention & concentration, perception and visuospatial skills. These processes may be directly or indirectly involved with the communication abilities of persons with dementia.
2.4.1 Memory deficits in dementia.

Memory problems are typically the first signs of cognitive decline across dementia. The memory problems often result in problem behaviors which can be explained by failure at different points in memory processing. There were different experimental tasks used to measure memory in persons with dementia. And they measured different types of memory such as working memory, episodic memory, sensory memory etc.

Working memory (WM) is the ability to actively hold information in the mind needed to do complex tasks such as reasoning, comprehension and learning. Working memory tasks are those that require the goal-oriented active monitoring or manipulation of information or behaviors in the face of interfering processes and distractions. Working memory (WM) processes are particularly vulnerable to the effects of dementia which are due to failure in executive control system. There is evidence of reduced memory span and short term memory (STM) capacity in dementia (Morries, 1986). They have increased rate of forgetting (Au, Chan & Chiu, 2003). They exhibit encoding deficits (Kesner, 1998). They have impairment in the ability to learn and remember new information but relatively preserved recognition and increased performance with cueing (Hoppe, Muller, Werheid, Thone, Mungersdorf, & Von Cramon, 2000).

Belleville, Peretz and Malenfant (1996) examined verbal and attentional components of working memory in patients with Alzheimer's disease, normal elderly, and healthy young adults. Persons with Alzheimer's disease showed a reduced attention span but were sensitive to word length. This is indicative of a functional rehearsal procedure. However, the effect of phonological similarity on immediate recall was smaller in persons with Alzheimer's disease and they showed a depressed performance in tasks of phonological analysis. There was also a significant decrement in a task that assessed the attentional component of working memory. Examination of individual patterns of performance showed that the phonological deficiency was severe in a subgroup of DAT while the attentional deficit was more general.
Persons with Alzheimer’s disease experience frontal lobe pathology and deficits in working memory processes are well documented. The performance data of persons with mild and moderate Alzheimer’s dementia on five tests of language comprehension and four tests of language expression were discussed by Bayles (2003) in the context of possible contributions from impaired working memory functions. The argument suggested that diminished scores on tests of language comprehension and production result primarily from attenuated span capacity, difficulty focusing attention, encoding, and activation of long-term knowledge rather than from loss of linguistic knowledge.

2.4.1.1 Deficits in Episodic memory (EM) in dementia.

Episodic memory (EM) is the memory of autobiographical events (times, places, associated emotions, and other contextual knowledge) that can be explicitly stated. Not only working memory, episodic memory is also vulnerable to disease progressing because of the need to encode new information frequently when experiencing some events (Caselli & Yangihara, 1991).

Greene, Baddeley and Hodges (1996) assessed anterograde episodic memory in 33 persons with early dementia of Alzheimer type (DAT) and 30 matched normals using immediate and delayed prose recall, the CERAD word learning test and the test of visual and verbal recall and recognition. DAT showed markedly impaired learning on all three measures, with little evidence of accumulation of information across trials. They showed more forgetting than normals on prose recall and the CERAD word list, but more detailed analysis suggested that this differential loss was attributable to the contribution of primary memory to immediate but not delayed recall. It was concluded that the episodic memory deficit in DAT is general in nature and primarily reflects impaired learning rather than accelerated forgetting or disrupted retrieval.

2.4.1.2 Deficits in Semantic memory (SM) in dementia.

Semantic memory (SM) refers to the memory of meanings, understandings, and other concept-based knowledge unrelated to specific experiences. The conscious recollection of factual information and general knowledge about the world. Semantic
memory refers to the enormous storehouse of information that humans have readily accessible.

Chertkow, Bub, and Seidenberg (1989) examined three methodological issues concerning the measurement of semantic memory impairment in persons with brain-damage. Ten carefully selected persons with dementia of Alzheimer's type (DAT) and anomia were studied. A battery of perceptual tests and direct tests of semantic memory were used. The first issue addressed in this DAT group was whether verbal fluency impairment accurately reflected the loss of semantic memory. It was found that verbal fluency (generation of semantic category lists) was impaired due to two major constraints: deterioration of semantic memory store, and variable difficulties in semantic search. Verbal fluency, therefore, reflects semantic memory loss to some degree, but is not a direct test of semantic memory store in DAT. The second issue was whether semantic memory impairment in the DAT confirmed to the ‘semantic storage disorder’ syndrome. It was shown that the DAT demonstrated co-occurrence of consistency of errors, loss of semantic cueing, and preserved superordinate knowledge with loss of detailed knowledge of concept items.

2.4.1.3 Deficits in Executive Function (EF) in dementia.

The executive system is a theorized cognitive system in psychology that controls and manages other cognitive processes. It is responsible for processes that are sometimes referred to as the executive function, executive functions, supervisory attentional system, or cognitive control. Planning, shifting, mental set, inhibiting incorrect responses, manipulating new information, violating purposive action, self monitoring are the components of EF (Assal & Cummings, 2003). Deficits involving EF causes difficulty in performing instrumental activities of daily living. EF for complex tasks and problem solving declines with increase in severity of dementia. Initiation and planning problems are the earliest signs of EF dysfunction. Theory of mind (TOM) or ability to infer what another person knows by taking his/ her perspectives is the component of EFTOM deficits concomitant with cognitive impairment in Persons with mild dementia. WM, EF influences the TOM.
Voss and Bullock (2004) investigated the role of executive control function (ECF) within the dementia syndrome between Alzheimer’s disease (AD) and vascular dementia (VaD). 307 persons with AD, 168 persons with VaD and 208 normals were compared on tests of cognitive function. Results indicated that controls outperformed both clinical groups (p < 0.001) on all tests. AD performed more poorly than VaD on 11 of the 18 cognitive tests (p < 0.05). Factor analysis of patient data indicated the existence of 3 factors generated from the battery of tests, relating to episodic memory, ECF and face recognition. It was primarily on tests of ECF that the AD and VaD groups did not differ significantly. It is concluded that ECF is a feature of cognition shared by the two pathologies, giving rise to an obligation to reconsider the current understanding of the core cognitive feature of dementia.

2.4.2 Attention and concentration in early stage of dementia.

Attention is the process of focusing on a specific stimulus (selection), for a particular length of time (sustain), attending multiple stimulus (divided or shifting focus from one stimuli to another (shifting sets) (Norman & Shallice, 1986). Persons with dementia have difficulty in more complex tasks which require divided attention such as listening for target word in a list (Perry & Hodges, 1999). Attention for simple tasks only selecting and sustaining are not typically impaired in early dementia (Assal & Cummings, 2003). They also have preserved performance on sustained attention. When physical characteristics of the target and environmental stimuli are similar, discrimination skills become challenged with more errors, increased confusion with longer response time (Baddeley, 2001; Foldi et al., 2005). When multiple and competing demands for attention exceed the capacity, reaction time suffers because of difficulty in deciding which task to attend. This is the problem related to inhibitory skills of EF (Baddeley, 2001; Foldi, Loosco & Schaefer, 2002).

Parasuraman, Greenwood, Haxby and Grady (1992) examined spatial attention for a letter-discrimination task in 15 persons with mild to moderate dementia of the Alzheimer type (DAT) and 15 healthy, age-matched normals. Spatial cues were valid, invalid or neutral in indicating probable target location and were presented either
centrally at fixation or peripherally 6.7° to the left or right of fixation. Stimulus-onset asynchrony (SOA) between cue and target was varied between 200 ms and 2000 ms. Reaction time (RT) for valid cues did not differ between the DAT group and the normals. However, RT costs incurred by invalid cues were significantly greater in the DAT group than in the normal group. Group differences in RT costs plus benefits occurred at short SOAs (<500 ms) for peripheral cues and at long SOAs (>500 ms) for central cues. Reaction time costs plus benefits were correlated with right-left asymmetry in resting levels of cerebral glucose metabolism in the superior parietal lobe for DAT patients but not for normals. The results indicate that focusing of attention to spatial location is intact in early DAT, whereas the disengagement of visuospatial attention is impaired. Automatic attention shifts elicited by peripheral cues reveal abnormalities earlier than attention shifts initiated ‘effortfully’ by central cues. Intact focusing and impaired disengagement of visuospatial attention may be linked to dysfunction in early DAT of cortico-cortical networks linking the posterior parietal and frontal lobes.

Mosimann, Mather, Wesnes, O’Brien, Burn, and McKeith (2004) quantified visual discrimination, space-motion, and object-form perception in persons with Parkinson disease dementia (PDD), dementia with Lewy bodies (DLB), and Alzheimer disease (AD). They used a cross-sectional study to compare three groups with persons with dementia matched for overall dementia severity and two age, sex, and education matched normal groups. Visual perception was globally more impaired in PDD than in normals, but was not different from DLB. Compared to persons with AD, persons with PDD tended to perform worse in all perceptual scores. Visual perception of persons with PDD/DLB and visual hallucinations was significantly worse than in persons without hallucinations. Parkinson disease dementia (PDD) is associated with profound visuoperceptual impairments similar to dementia with Lewy bodies (DLB) but different from Alzheimer disease.

2.4.3 Abstraction and problem solving processes in dementia.

An impairment of abstract thinking and problem solving and a deficient ability to shift or maintain set are often prominent clinical features of dementia (Cummings &
Benson, 1983). These deficits are usually caused due to the neuropathological changes in the association cortex of the persons with dementia. These problems present differently across the stages of dementia and are more prominent in the middle stage of the disease. Freedman and Oscar-Berman (1986) studied the problem solving impairment in persons with dementia using a tactile discrimination test. The impaired performance in these people resulted from the deficiency in the cognitive flexibility that is required to alternate responses and shift mental set.

2.4.4 Visuospatial abilities in persons with dementia.

Vision is defined as the process of ‘seeing with our eyes’, which give us a representation of the world around. ‘Perception’ is the process that allows us to provide meaning to the things we see (Jones, et. al., 2006). Williams (1959) stated that ‘it is not that the persons with dementia are unable to receive information through his senses, but that they are unable to select or abstract from all the information available that which is relevant’. Persons with dementia experience significant number of ‘visual mistakes’ that are linked to their ‘thinking errors’ which is the combination of ‘seeing-thinking’ illness or ‘visuoperceptual-cognitive’ illness (Jones, 2006). Visuospatial dysfunction is also a prominent feature of persons with dementia. These dysfunctions are independent of the lower level of visual functioning. The higher level of visuospatial dysfunctions are evident in persons with dementia on tests of constructional apraxia, including Block-design subtest from the Wechsler Adult Intelligence scale revised (WAIS-R) and drawing tasks (Berg, et.al, 1984; Benton, 1985; Becker, Huff, Nebes, & Holland, 1988). Drawing tests usually involve spontaneously drawing to command or copying abstract complex figure, clocks, and two-dimensional representations of a cube. In addition the persons with dementia have difficulty in visual discrimination and visual-matching tests (Berg Danzinger, & Storandt, 1984; Martin, Cox, Brouwers, & Fedio, 1985; Becker, Huff, Nebes, & Holland, 1988). Persons with dementia exhibit either primarily verbal or visuospatial deficit which correlate with the greater glucose hypometabolism in the left or right hemisphere, respectively (Koss, Friedland, Ober, & Jagust, 1985; Martin, 18987; Becker, Huff, Nebes, & Holland, 1988).
Mori et. al., (2000) examined the visuoperceptual disturbance in persons with Lewy body dementia (DLB) in comparison with that in persons with Alzheimer disease. They explored the relationship between visuoperceptual disturbance and the vision-related cognitive and behavioral symptoms. Twenty-four persons with probable DLB and 48 persons with probable Alzheimer disease were matched to those with DLB for age, sex, education, and Mini-Mental State Examination score. Visual perception is defective in probable DLB. The defective visual perception plays a role in development of visual hallucinations, delusional misidentifications, visual agnosias, and visuoconstructive disability characteristic of DLB.

Uhlhaas et. al, (2008) examined the perceptual organization skills in persons with AD, vascular dementia, frontotemporal dementia and mild cognitive impairment and age-matched healthy normals. Persons with AD differed significantly in their ability to detect contours as detection relied increasingly on long-range spatial interactions. Impairments in contour integration were particularly pronounced in AD with atrophy and gliosis of white matter in the occipital lobe. Deficits in perceptual organization were not found in persons with other dementias and participants with mild cognitive impairment. These results suggest that a subgroup of persons with AD is characterized by a specific deficit in visual perceptual organization, which might reflect the impaired functional integrity of occipital cortico-cortical pathways.

Mosimann, Mather, O'Brien et. al (2004) quantified visual discrimination, space-motion, and object-form perception in persons with Parkinson disease dementia (PDD), dementia with Lewy bodies (DLB), and Alzheimer disease (AD). They used a cross-sectional study to compare three groups with dementia matched for overall dementia severity, age, sex, and education matched normal groups. As a result, visual perception was globally more impaired in PDD than in normals but was not different from DLB. Compared to AD, persons with PDD tended to perform worse in all perceptual scores. Visual perception of persons with PDD/DLB and visual hallucinations was significantly worse than in patients without hallucinations. Parkinson disease dementia (PDD) is associated with profound visuoperceptual impairments similar to dementia with Lewy
Review of Literature

bodies (DLB) but different from Alzheimer disease. These findings are consistent with previous neuroimaging studies reporting hypoactivity in cortical areas involved in visual processing in PDD and DLB.

2.5 Linguistic skills during healthy aging

2.5.1 Aging and language processing.

Normal elderly usually retain their memory store for single word processing and the semantic associations between them. Hence they perform better on single word tasks. But the ability to retrieve words is slow in elderly. Hence, the elderly benefit more when asked to retrieve single words for a particular context. When language comprehension is taken into account, far less is known about the ability to process sentences or larger units of text. But, in sentence repetition and phrase repetition tasks, the elderly do perform low on lengthy and complex sentences. Research also reveals an intact language competence and minimally impaired language performance, both in understanding and language production in elderly population (Maxim & Byran, 1994).

There is a positive age related changes in cognitive abilities related to vocabulary in elderly. That is, their vocabulary continues to grow with age, such that older adults have larger vocabularies than younger ones. Despite this positive change there is problem in retrieving lexical information from memory. Connor et al., (2004) presented a longitudinal data from the Boston naming test and found that performance declined an average of 2% per decade. Along with these difficulties older adults show problems in lexical retrieval which is often referred as tip-of-the-tongue (TOT) state. According to TOT, a person temporarily cannot recall a well known word. The frequency of TOT states seems to increase with age (James & Burke, 2000).

2.5.2 Aging and understanding language.

Elderly people have greater difficulty understanding sentences that are complex either in grammatical form or in semantic structure, or in both (Davis & Ball, 1989). Sentence length does not appear to be an important factor in the ability of the elderly to understand language, but both increased sentence complexity and speed of delivery have
shown to impair the ability of elder people to comprehend (Jacoby & Hay, 1998).

Aging is also associated with changes in the auditory system, including temporal processing of speech (e.g., Pichora-Fuller, 2003). Older adults have difficulty in differentiating voiced from unvoiced consonants (e.g., /b/ and /p/), a discrimination that requires detection of the presence or absence of a voice onset time gap of 20-40ms in duration (Tremblay, Piskosz & Souza, 2002). There is also considerable variation in acoustic perception of speech sounds spoken by different speakers. Listeners maintain perceptual constancy in the face of this variability by a process known as perceptual normalization (Pisoni, 1993). Older adults have poor perceptual normalization abilities than young adults, i.e., their word identification performance suffers more when words are presented by many talkers rather than by a single speaker (Yonan & Sommers, 2000).

Understanding the ability of the language plays a major role in production of the same. As elderly encounter difficulties in understanding lengthy and complex utterances, their production of complex language elements may also be affected.

2.5.3 Aging and spoken language.

Studies of connected discourse produced by elderly people suggest that, there may be errors of reference and fewer propositions than in the language of younger people. There may be a reduction in types of clause structure and verb phrases, but little change in sentence length (Bayles, Kazniak, & Tomoeda, 1987). Obler and Albert (1981) reported that discourse may become more elaborate syntactically, yet less fluent in its utterance and active use of lexicon may falter although passive is preserved. Thus, most studies suggest diminution of language performance, but adequate communication. Hence there is a need to study the discourse abilities in elderly. And when this is the case of monolinguals, there should be some differences in performance of bilinguals.

Discourse produced by older adults is rated as highly as that of young adults for story quality, interest, clarity, and informativeness (Kemper, Kynett, Rash, O’Brien, & Sportt, 1989, Kemper, Rash, Kynette, & Norman, 1990; James & Burke, 2000). When
asked to interpret stories, older adults are more likely to generate elaborated, integrative, symbolically rich responses than young adults. But older adults may recall less of the literal propositional content when asked to do so (Adams, Smith, Nyquist, & Perlmutter, 1997). This pattern of reduced grammatical complexity, increased structural complexity, and greater elaboration does not, however mean that all aspects of discourse become easy to read or listen in old age. Decreased cohesiveness and greater likelihood of ambiguous reference have also been reported (e.g., Kemper et. al.,1990; Pratt, Boyes, Robins, & Manchester, 1989; Adams, Smith, Pasupathi & Vitolo, 2002).

Hence it is understood that communication is a manifestation of cognition. The simple act of object naming requires perception, access to long term memory, association, recognition, lexical retrieval, decision-making, motor planning, and self-monitoring (Ross-Swain, 1992). Then, the complete act of discourse needs association between short term and long term memory. When healthy elderly face deficits of cognitive-linguistic skills, then this will be exaggerated in adults with neurogenic communication disorders which encompass a variety of specific abnormalities all caused by nervous system pathology. Their features, severity and outcome reflect the location, magnitude and nature of the abnormality. And these deficits emerge as dynamic and range from subtle to severe. Present study is primarily based on persons with mild dementia.

2.6 Cognitive decline, communication and dementia

Feyereisen, Berrewaerts and Hupet (2006) aimed to study to what extent persons suffering from DAT can benefit from shared experience through trial repetition to achieve common reference. They considered 13 persons suffering from DAT at minimal or mild stage (MMSE score range 518–27) and 13 healthy elderly adults (64–86 years) in neuropsychological assessment of executive functions and in a referential communication paradigm. Persons with DAT produced a larger number of words than control participants and they benefited from the task repetition. However, they were less able to take into account previously shared information. They did not use definite referential expressions and were more idiosyncratic in their descriptions of the referent. This decline
of communicative effectiveness was found not to relate closely to executive deficits. This process is severely disturbed in persons with DAT, in relation to poor memory of preceding episodes or to other cognitive impairments.

### 2.7 Linguistic skills and their deficits in Dementia

The presence of memory impairment in any form (recognition, encoding, and retrieval) will interfere with language production, and comprehension to some extent, and will vary over the course of the illness. When tasks are shorter and commands are repeated, with slow rate of speech and providing contextual and written cues, linguistic memory is not affected in persons with mild dementia (Bayles, 2003).

Early cognitive linguistic changes in discourse might be helpful for the preclinical identification of dementia. PWD exhibit significant impairment in gist and details (Chapman, 2002). Lexical semantic processing, semantic paraphasia, word finding difficulty, fewer error repairs, fewer themes identification are observed in persons with dementia (Forbes, Venneri & Shanks, 2002). In picture description tasks persons with mild dementia produce meaningful and relevant description and figurative statements using accurate sentence structure and grammar (Hopper, Mahendra, Azuma, Bayles, Azuma, & Kim, 2001). But the complexity of the stimuli used to elicit discourse can influence the performance.

**2.7.1 Syntactic comprehension deficits.**

Bickel, Pantel, Eysenbach and Schroder (2000) investigated syntactic comprehension of German persons with dementia. Semantically reversible sentences were used in a sentence picture matching paradigm. Syntactic complexity ranged from simple active voice sentences to more complex sentences. Persons with dementia showed deficit in all the categories. Syntactic comprehension is only mildly affected in the early stages of Alzheimer’s disease. They suggest that the syntactic processing demands the intact working memory processes.
2.7.2 Word finding difficulties.

Various studies have reported word-finding difficulties and a decline in semantic abilities in persons with DAT (Light, 1992; Kempler & Zelinski, 1994). Many structured tasks were used to assess persons with DAT, such as confrontation naming (Eg. Bayles, 1982; Bayles & Kaszniak, 1987, Hodges, Salmon, & Butters. 1991), single word production (Eg. Martin & Fedio, 1983), or generation of words beginning with a certain letter (Phillips, Sala, & Trivelli, 1996).

Ash, Moore, Antani, McCawley, Work, and Grossman (2006) assessed discourse in persons with progressive nonfluent aphasia (PNFA), persons with semantic dementia (SemD), and nonaphasic persons with a disorder of social comportment and executive functioning (SOC/EXEC) to narrate the story of a wordless children’s picture book. They found significant discourse impairments in all three groups of individuals. Moreover, there were qualitatively important differences between the groups. Persons with PNFA had the sparsest output, producing narratives with the fewest words per minute. Persons with SemD had difficulty retrieving words needed to tell their narratives. Aphasic, persons with SOC/EXEC had profound difficulty organizing their narratives, and they could not effectively express the point of the story. Impaired day-to-day communication in nonaphasic frontotemporal dementia persons with a disorder of social comportment and executive functioning is due in part to a striking deficit in discourse organization associated with right frontotemporal disease.

2.7.3 Auditory comprehension in dementia.

A person who is both elderly and has dementia may have impairments in understanding and processing speech that might be more easily overcome by a person with similar auditory impairment, but who is cognitively intact. The comprehension of spoken language, or auditory comprehension, is gradually impacted by the cognitive deficits experienced by the persons. Social isolation behaviors may be the first signs of difficulties in this area. Auditory comprehension appears to be intact for simple, structured, and concrete language, but impaired for abstract language, even in early
stages, due to a lack of attention or concentration, encoding, or working memory deficits (Code & Lodge, 1987; Kempler, Van Lancker, & Read, 1988). Welland, Lubinski, and Higginbotham (2002) found that persons with early and middle stage of dementia demonstrate poorer discourse comprehension of narrative than healthy elderly. But they exhibit better understanding of main ideas than details, and better comprehension for stated than implied information.

Gates, Karzon, Garcia, Peterein, Storan, Morries, and Miller (1995) determined the prevalence and type of auditory dysfunction in persons with mild probable Alzheimer's disease. Pure-tone thresholds, word recognition in quiet, Synthetic Sentence Identification with Ipsilateral Competing Message or Contralateral Competing Message, distortion-product otoacoustic emissions, and auditory brain-stem responses were done in 82 elderly among whom 42 had a clinical diagnosis of mild probable Alzheimer's disease. Central auditory dysfunction was evident in participants with even mild with dementia, whereas peripheral auditory function was not different from that in age-matched normal participants.

Language deficits in perception and production are reserved at an average level till the late stage of AD. Imamura, Takatsuki, Fujimori, Hirono, Ikejiri, & Shimomura, (1998) examined 150 persons with mild to moderate AD. Word comprehension and sequential commands testing revealed greater deficits in early onset persons than in late onset ones. The existence of greater comprehension impairments in the early onset AD persons has been confirmed by other studies (Imamura, Takatsuki et. al (1998); Binetti, Magni, Padovani, Cappa, Bianchetti, & Trabucchi, 1993).

**2.7.4 Reading comprehension in dementia.**

Working memory deficits are thought to account for deficits in reading comprehension of sentences (Kempler, Ferrell, Harden, Finter-Urczyk, & Billington, 1998). The comprehension of text reflects the auditory comprehension abilities and deficits which gradually declines the ability to understand text. Reading deficits may be attributed to memory-encoding deficits, difficulty keeping multiple ideas in mind and
making inferences, or long-term and semantic memory deficits (Bourgeois & Hicky, 2009).

2.7.5 Conversational abilities in persons with dementia.

With the growing interest to speech language pathologists and neuropsychologists, communicative impairment present in persons with dementia had become the area of research. A consensus exists that persons with mild to moderate dementia show relatively preserved phonologic, syntactic and lexical knowledge while semantic and pragmatic knowledge are markedly impaired (Appell, Kertesz & Fisman, 1982; Bayles, 1982; Emery & Emery, 1983; Murdoch, Chenery, Wilks & Boyle, 1987). A few studies on general discourse measures are as follows.

Studies of oral and written language indicate that persons with DAT produce language of reduced syntactic complexity. The ability of such participants to use more simple constructions correctly nonetheless seems to be preserved (Kempler, LaBarge, Ferraro, Cheung, Cheung, & Storandt, 1993; Lyonds, Kempler, LaBarge, Ferraro, Storandt, & Balota, 1993). They show almost no deficiencies in identifying defective sentences and further-more show a tendency to correct syntactic errors more frequently than phonological and semantic ones (Cushman & Caine, 1987). Hence it is concluded that if correct sentences are produced, and defective sentences are identified and corrected, the observed difficulties in sentence reception are most likely owing to a deficit in performance rather than owing to lacking competence (Bickel, Pantel, Eysenbach, & Schroder, 2000).

DAT is characterized by a degradation of semantic networks (Ralph, et al., 2001), evidenced by reduced confrontation-naming and semantic verbal fluency performances on standardized testing (Zakzanis, Leach, & Kaplan, 1999). The language decline in DAT is accompanied by decline in other cognitive domains, as opposed to the circumscribed language breakdown seen in aphasia. Hence the DAT provides a platform to explore discourse production in the context of a broader pattern of cognitive impairments, given
that discourse performance may be affected by changes in abilities such as working memory (Almor, Kempler, MacDonald, Andersen, & Tyler, 1999).

Research to date indicated that discourse changes in DAT are predominantly pragmatic in nature (e.g., difficulties in expressing communicative intentions, maintaining languages and information balance, and drawing inferences) (Ripich, Vertes, Whitehouse, Fulton, & Ekelman, 1991; Garcia & Joanette, 1994; Watson, Chenery, & Carter, 1999). Compared to the age-matched healthy elderly, the language content in DAT is reduced with fewer narrative themes, information units and nouns (Bayles, Boone, Tomoeda, Slauson, & Kasniak, 1989; Bucks, Singh, Cuerden, & Wilcock, 2000). In contrast, there is an increase in the number of pronouns with no antecedents or referents, deictic words, demonstratives, and pronouns along with a higher rate of referential errors (Hier, Hagenlocker, & Shindler, 1985; Almor, Kempler, MacDonald, Andersen, & Tyler, 1999).

2.7.5.1 Turn taking.

There are several requirements for orderly conversational interactions. Among these requirements are (1) each participant has a chance to talk, (2) only one person talks at a time, (3) gaps between turns are brief, (4) the order of speakers and the amount that each says is not fixed before time, and (5) techniques are determined for deciding who speaks when (Clark & Clark, 1977).

Turn-constructional conversations determine turn content. Conversational turn-taking is reportedly maintained at the early and middle stages of dementia (Golper & Binder, 1981). The conversational abilities in persons with dementia are described based on the deviance with respect to the conversation skills of healthy elderly. Ripich and Terrell (1988) investigated conversations of six persons with dementia of Alzheimer’s type with the experimenter. They found that the persons with dementia produced shorter conversational turns and called for regular prompts from the interviewer.

Ripich, Vettes, Whiethouse, Fulton and Ekelman, (1991) examined the conversational turn taking and speech act patterns in the discourse of 11 persons with
SDAT (senile dementia of Alzheimer’s type) and 11 healthy elderly. As a result, words per turn differed with the examiner using shorter turns with SDAT. This pattern of compensatory shifts in discourse suggested retained flexibility in the communication system of early stage of SDAT.

2.7.5.2 Topic shifts.

Mentis and Whittekar (1995) examined the topic management in the discourse of 12 persons with dementia of Alzheimer’s type and healthy elderly. They found that the persons with dementia of Alzheimer’s type had a reduced ability to effectively introduce new topics and had difficulty in sustaining and contributing to topics. A similar result was found by Gracia and Joanette (1997) who investigated the topic shifts in the spontaneous speech of persons with dementia of Alzheimer’s type. Persons with dementia of Alzheimer’s type demonstrated unexpected topics shifts than healthy elderly which were due to failure to continue and repetition of ideas.

2.7.5.3 Information content.

Chenery and Murdoch (1994) investigated production of narrative discourse in response to computer generated animations in normal elderly and persons with dementia of Alzheimer’s type. The narrative samples produced with seven persons with DAT were compared on a variety of linguistic measures. The persons with DAT showed deficits in informative content, story schema, and cohesion. The animations provided a useful means of highlights of many of the discourse deficits in DAT in a consistent, sensitive, and time-efficient way.

Nicholas, Obler, Albert, and Helm-Estabrooks, (1984) states that the persons with DAT narrated less information about the animations than did the healthy elderly. Very few of the persons with DAT incorporated the more complex events into their narratives; events that require attention to contextual cues for correct interpretation or events of inferred humor. The inability to link the perceived events into a composite narrative often lead to incorrect interpretation of the events. Further, information that was considered by the healthy elderly to be central or necessary to the story (the so called core propositions)
was not always included in the narratives of persons with DAT. Omitting central pieces of information contributed to the considerable difficulty that the persons with DAT experienced in the story schema. On all measures of narrative structure (settling information and the inclusion of a complicating action and resolution) the persons with DAT differed significantly from the normals. Glosser and Deser (1990) similarly found defects at the suprasentential levels in the conversation of persons with DAT. The informative content of the narratives of persons with DAT was less precise than the normals with significantly less instances of specific reference.

Chapman, Ulatowska, Franklin, Shobe, Thompson, and McIntire (1997) compared proverb processing across three groups of elderly. They include persons with fluent aphasia (APH), persons with Alzheimer’s Disease (AD), and healthy elderly. Proverb stimuli were used to examine the effects of group membership and proverb familiarity in two presentation formats (i.e. spontaneous versus multiple-choice) on performance. The sensitivity of linguistic and cognitive measures as predictors of ability to interpret proverbs was also investigated. In relation to healthy elderly, persons with fluent APH exhibited significant difficulty formulating responses for familiar and unfamiliar spontaneous proverbs, whereas persons with AD demonstrated lower performance only on the unfamiliar proverbs. On the multiple-choice paradigm, persons with APH exhibited minimal difficulty. Conversely, the persons with AD manifested significant problems selecting the correct abstract response for familiar proverbs. Cognition was a sensitive predictor for unfamiliar proverb interpretations and to the multiple-choice format. Deficits on the proverb tasks were discussed with reference to the potential breakdown of underlying linguistic and cognitive processes.

Ash et al., (2009) assessed speech fluency in 35 persons with frontotemporal lobar degeneration (FTLD) who presented with progressive non-fluent aphasia (PNFA), semantic dementia (SemD), or a social and executive disorder without aphasia (SOC/EXEC). Fluency was quantified as the number of words per minute in an extended, semi-structured speech sample. PNFA people were significantly less fluent than healthy elderly and other persons with FTLD. Fluency correlated with grammatical expression but not with speech errors or executive difficulty. Persons with SemD and SOC/EXEC
were also less fluent than controls. In SemD, fluency was associated with semantically limited content. In SOC/EXEC, fluency was associated with executive limitations.

**2.7.5.4 Communication Intent.**

Chapman, Highley and Thompson (1998) compared discourse performance across three groups, i.e., persons with mild to high-moderate aphasia (APH), mild to early-moderate stage Alzheimer's disease (AD), and healthy elderly. Discourse was elicited for texts of varying linguistic and pragmatic difficulty using fables, single-frame pictures, and proverbs. Discourse was analyzed in terms of linguistic formulation and three pragmatic aspects including inferencing, interpreting communicative intentions, and ratio of language to information. The results revealed that the APH group received significantly lower scores than both the AD and healthy elderly groups on linguistic formulation. The persons with AD exhibited significant difficulties on the pragmatic domain of drawing inferences as compared to the APH and NC groups. The disparity in linguistic formulation and ability to draw inferences between AD and APH groups suggested that discourse differences at mild levels of impairment for these two neurological diseases are qualitatively different.

**2.7.5.5 Information adequacy.**

Brandao, Castello, Dijk, Parente and Pena-Casanova (2009) reported an investigation on the cognitive and linguistic mechanisms involved in knowledge management during discourse production of persons with Alzheimer disease (AD). Two discourse variables were examined, incomplete propositions and repeated propositions. Differences between normal elderly and participants with AD were found concerning the presence of incomplete propositions in a non-informative prompted task. Findings obtained with the informative prompted task suggested that knowledge management was more preserved in the early stage than in the later stage of AD. The majority of the neuropsychological data obtained in this study correlated with the presence of incomplete propositions. The discussion debated on whether this discourse deficit can be attributed to an impaired ability to manage knowledge provided in the context of communication.
2.7.5.6 Repair strategies.

Orange, Lubinski, and Higginbotham (1996) investigated conversational breakdown in persons with dementia of Alzheimer’s type. The results of this study indicated that there is greater need for repair as dementia severity increases. Specifically, the type of trouble sources noted in the turns of persons with dementia suggests that they were less efficiently able to follow themes and propositions. Repair initiators used by them were primarily non-specific requests for clarification or minimal queries.

Watson, Chenery and Carter (1999) investigated the frequency and nature of trouble and repair in conversations between persons with dementia of Alzheimer’s type and their conversation partners. In this study normal participants used a wide variety of repair trajectories and other-initiated repair. There were high proportions of self-initiated repair used by the persons with dementia. But they used self-initiated self repair of 81% effectiveness indicating the inefficiency to monitor and correct errors occurring during their current turn.

2.7.5.7 Deficits of Cohesion.

Shekim and La Pointe (1984) attempted to quantitatively describe aspects of discourse of nine persons with dementia of Alzheimer’s type clients and matched normal adults through several elicited narrative discourses such as expository or subject oriented discourse (picture story descriptions, telling a memorable story) and procedural (telling how something is done) discourse. The DAT adults were found to have fewer cohesive ties per content unit, more exophora or references to information outside the text, more performance deviations, slower speech rate and more maze (jumbled or confused) words. This study however, focused more on qualitative aspects rather than quantification of the discourse.

Lock and Armstrong (1997) measured the quantitative and qualitative use of cohesive ties in the expository discourse of groups of normal young adults, normal older adults, older people with anomic aphasia and older people with probable Alzheimer’s disease (AD). The study aimed to describe patterns of cohesion for each group, to
Review of Literature

compare group patterns and to focus on whether any variations in use could significantly
differentiate the discourse of people with AD from that of people with anomic aphasia. Results revealed both quantitative and qualitative differences in the discourse cohesion of the groups, indicating how language use changes through senescence and pathology. Significant differences in the quantity and patterns of use of cohesive ties in the discourse of people with anomic aphasia and people with AD revealed that cohesion analysis can differentiate the language disorders found in these two groups.

Romero and Kurz (1996) studied 63 persons with Alzheimer’s disease and rated their spontaneous speech during a four minute interview on six scales (communication, articulation and prosody, automatic speech, semantic structure, phonemic structure and syntactic structure). They found qualitative difference in the speech of persons with Alzheimer’s disease as compared to normal elderly.

2.7.5.8 Coherence.

Laine, Laakso, Vuorinen and Rinne (1998) examined the coherence and informativeness of discourse in persons with vascular dementia (VaD), probable Alzheimer’s disease (AD) and age- and education-matched normal elderly by analyzing work history interviews. The clinical groups had comparable levels of cognitive impairment (mild-to-moderate dementia). The results show that both persons with VaD and AD exhibited impaired global thematic coherence and reduced informativeness in their discourse. Whereas, the degree of local coherence between two successive utterances did not reliably differentiate the clinical groups from the normal elderly. Correlational analyses showed that global coherence was the only discourse variable related to conceptual/semantic impairment.

Dijkstra, Bourgeois , Allen and Burgio (2003) compared the discourse profiles of 30 nursing home residents with dementia and of 30 healthy older adults. A total of 60 transcripts of interview style conversations were analyzed using a discourse analysis schema. The results revealed a higher frequency of discourse building features, such as coherence and cohesion, for healthy adults compared to adults with dementia.
Conversely, discourse-impairing features, such as disruptive topic shifts and empty phrases, were found more often in conversations of adults with dementia as compared to healthy adults. Conversational partners deviated from their conversation protocol when talking to adults with dementia by including facilitative strategies in the conversation. The discourse features in interview style conversations in adults with dementia reflect declines in their memory.

2.7.5.9 Linguistic non-fluency.

Kunishige and Maeda (2006) aimed to evaluate whether a discourse analysis can be of use in assessing the progress of senility and dementia. The relationship between the frequency of inappropriate demonstratives, redundant terms such as fillers, and unnecessary pauses (hereafter senility elements) in conversations by normal participants and their age and gender was analyzed. Also, the relationship of the frequency of senility elements in conversations of persons with dementia with the severity was examined. The results of the analyses showed that there was a clear correlation between age and the frequency of senility elements, and that there was a correlation to some extent between the level of dementia and the frequency of senility elements. The results implied that the discourse analysis has the potential to be used for assessing the progress of senility and dementia.

2.7.6 Studies on T-unit based analysis.

Ulatowska and Cannito, (1988) investigated the discourse performance of persons with vascular dementia across a range of tasks such as retelling a story, detailing a procedure, describing a picture story and providing a summary. The DAT participants relative to the normal adults were more prone to fewer propositions in the picture story task and more irrelevant steps in the procedures. They also produced more incomplete sentences and showed an abundance of reference errors such as higher propositions of pronouns to nouns and more deictic of language produced. This was described in number of T-units, length of T-units and clauses. But a drawback in this study is the focus on propositional aspects of discourse, which studies the individual’s performance in a
particular production task only. It is necessary to study the non-propositional aspects since they provide the information on interactional abilities in these individuals along with their revision behaviors.

Sevush, Leve, and Brickman (1994) assessed language in 150 persons with DAT using spontaneous speech, comprehension, repetition, oral reading, writing and naming. Spontaneous speech was evaluated for fluency, syntax and paraphasias. Each participant’s performance was graded as normal, mildly impaired, or markedly impaired. They found differences in persons with early and late onset DAT participants’ performances on these measures. Interestingly object naming was worse in late onset DAT, but spontaneous speech was worse in early onset DAT participants.

2.7.7 Studies on measures of richness of vocabulary.

There are also studies which have used spontaneous speech and measured the vocabulary strength in persons with dementia. Blanken, Dittman, Haas, and Wallesch (1987) used a semi-standardized interview to compare the performance of 10 DAT, five Wernicke’s aphasics and five normal older adults on spontaneous speech. The speech of these participants was transcribed and a mixture of methods were used to analyze the conversations, including measures of average sentence length (divided into simple and complex sentences), number of words in each class (nouns, verbs, adjectives and adverbs), type token ratio and instances of word finding difficulties. Significant differences between participant groups were found.

Bucks, Singh, Cuerden and Wilcock (2000) analysed linguistic measures in spontaneous conversational speech in probable dementia of Alzheimer’s type. They considered 24 participants (8 persons with dementia and 16 healthy elderly) for the study. They measured noun rate, pronoun rate, verb rate, adjective rate, clause-like semantic unit (CSU), type token ratio (TTR), Brunet’s index (W) and Honore’s Statistic (R). Results suggest that these measures offer a sensitive method of assessing spontaneous speech output in DAT and these serve as diagnostic and prognostic tools for use in clinical trials.
Until recently most psycholinguistic research has aimed to understand the representation and use of a single language. There might be difference in expressive language in the individuals who are exposed to more than single languages.

2.8 Bilingual language production.

For bilinguals, expressing and comprehending a communicative intention may be an inherently competitive process. They must manage competing phonological, syntactic and prosodic systems and in reading they must manage distinct mappings of orthography to phonology. More specifically, lexical nodes or lemmas, i.e., syntactically specified lexical concepts in different languages may compete for selection (e.g., Green, 1986, 1993, 1998; Hermans, Bongaerts, de Bot, & Schreuder, 1998; Kroll, Bobb, & Wodniecka, 2006; Lee & Williams, 2001; Poulisse, 1999). If competition is a fact of life, then bilinguals may become adept specifically at selecting responses in the face of competing cues even in a non-verbal task: a prediction proposed and confirmed by Bialystok (Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok, Craik, & Ryan, 2006).

Compared to monolingual speakers, bilinguals are slower to name pictures but do not differ in the time required to access their meaning in order to classify their referents as human-made or natural (Gollan, Montoya, Fennema-Notestine, & Morries, 2005). There is a relative delay in naming reflects the fact that bilinguals are in fact less practiced in naming words in either of their languages. Words in their mental lexicon are effectively at a lower level of functional frequency. Consistent with this claim (see Michael & Gollan, 2005 for a review), diary studies and experimental studies indicate that bilinguals are more susceptible to tip-of-the-tongue states, except where the target is a cognate or a proper name. In both these cases, the same word (or a very similar word form) can be produced in either language.

In the language switching paradigm, a key finding is that in naming numerals or in naming pictures bilinguals take longer to switch into their more non-dominant language. There is competition to name and produce the name in the less dominant language, the more dominant one must be suppressed (Green, 1998). Alternative names (phonological forms) enter a speech output buffer and the non-target phonological form is
either inhibited (Green, 1986) or is blocked from production in some other fashion (e.g., Finkbeiner, Almeida, Janssen, & Caramazza, 2006; Finkbeiner, Gollan, & Caramazza, 2006).

### 2.8.1 Neurolinguistics of bilingualism.

There is an argument that there is a single network mediating the representation of a person’s L1 and L2 and that this network is modulated by the control structure. Klein, Milner, Zatorre, Meyer, and Evans, (1995) performed PET scanning during word generation and word translation in twelve late but high proficient bilinguals of French–English. They found convergent brain activity pattern mainly located in the left frontal lobe.

Kim, Relkin, Lee, and Hirsch, (1997) examined sentence generation in L1 and L2 in a heterogeneous group of six late bilinguals using fMRI. Divergent brain activity was observed in Broca’s area. Similarly Perani, Abutalebi, Paulesu, Brambati, Scifo, and Cappa, (2003) used fMRI for studying word generation in a group of early and high proficient bilinguals but exposed differentially to L2. There was more extensive brain activity observed for the language to which subjects were less exposed.

Rueschemeyer, Fiebach, Kempe, and Friederici, (2005) used fMRI for assessing grammatical and semantic judgment in 14 late Russian-German bilinguals. Specific engagement of the left inferior frontal gyrus, superior temporal gyrus and basal ganglia was found when processing the non-native language. Chee, Soon, & Lee (2003) used fMRI to study the word repetition within and across languages in 12 early and high proficient English–Chinese bilinguals. There was more extended left prefrontal activity for the ‘across language’ switching Condition. Lehtonen, Niska, Wande, Niemi, & Laine (2005) used fMRI during sentence translation of 11 late Finnish–Norwegian bilinguals and found the selective activation of the left inferior frontal gyrus and left basal ganglia in these individuals during translation.

Byalistok, Craik and Freedman (2007) and Byalistok, Craik and Ryan (2006) have shown that bilingualism has a crucial effect on cognitive processing, mainly when considering executive functions. Specifically, the authors report a bilingual advantage on
tasks that require executive control; this advantage is observed across age windows but is particularly prominent in the elderly. Moreover, Byalistok, Craik and Freedman (2007) report a four-year delay in the appearance of the first signs in a group of bilinguals presenting Alzheimer’s disease, in comparison to monolingual Alzheimer’s patients. These data are in accordance with the hypothesis of the establishment of a greater number of connections in the bilinguals’ brain (Giussani et al., 2007), and suggest that bilinguals could have access to a cognitive reserve which could compensate for the early signs of healthy and unhealthy aging.

2.9 Dementia and Bilingualism.

As literacy and bilingualism became area of interest to different disciplines, researchers were interested to study the changes in bilingual individuals. The area of focus was the effect of bi/multilingualism on the language comprehension, languages production and cognitive functions. There have been studies on aphasia, traumatic brain injury and dementia. Of growing interest to speech language pathologists and neuropsychologists is the communicative impairment present in persons with dementia (Hyltenstam & Obler, 1989; Rabadán, 1994; McMurtray, Saito, & Nakamoto 2009). Bilingualism is an area of linguistics that has been investigated in persons with aphasia. However, bilingualism and dementia have not been fully investigated despite the fact that language impairment is a frequent symptom of dementia.

Hyltenstam and Stroud (1993) reported on two patients with DAT who had difficulties in language choice. They would choose the inappropriate language as a base language when speaking to a monolingual interlocutor and they would code-switch with a monolingual interlocutor. Although these patients made many pragmatic errors in each of their languages, there was differential ability for these patients in their two languages. One person with dementia showed a substantial advantage in the first-learnt language and the other patient showed a smaller advantage in the first-learnt language. This study disagrees with the general notion that, persons with dementia experience the progressive decline in the language abilities in all learned languages and increased interference
among them. In persons with dementia there is a tendency to retreat to single language and it is always towards the first acquired language.

Obler, De Santi and Goldberger (1995) attempted to determine the kinds of code switching and language choice errors that may occur in bilingual persons with DAT. They were tested in 4 to 6 sessions, on different days, in Yiddish and English. Formal testing was done with the patients to determine their level of language break. Subtests of Boston Diagnostic Aphasia Exam, the Boston Naming Test and the Action Naming test were used. The results showed breakdown in language choice and code-switching in some bilingual patients with dementia. Code switching is inappropriately used by the bilingual persons with dementia may be explained by disinhibition. The healthy individual however, must choose only one of the two languages. The persons with dementia do not make language choice appropriately and therefore does not inhibit the other language. The study fails to explain as to why code switching is inappropriate. In the point of disinhibition, there should be decline in both the languages, so switching of language is difficult. That is because both the languages are equally affected. But it is not the case in persons with dementia. They are unaware of the language choice they make. As they show the tendency to retreat to single language, they exhibit code switching in their second language. This was not present in their first language.

Mendez, Perryman, Ponton and Cummings (1999) studied 51 bilingual persons with dementia (31 DAT, 9 vascular, 5 frontotemporal and 6 mixed type of dementia). Fluency in English was assessed in all these individuals using general conversation. Patients presented an evident tendency for words and phrases from native language to intrude into English conversational speech. They tended to present asymmetrical language impairment with preferential preservation and use of the first acquired language.

Picciotto and Friedland (2001) investigated verbal fluency abilities in 30 healthy elderly English-Afrikaans bilingual speakers, and 6 bilingual persons with Alzheimer's disease. Three 1-min semantic verbal fluency tasks (animals) were obtained in the bilingual mode, Afrikaans and English. Results were analysed in terms of total correct
and semantic clusters. There was no significant difference between monolingual and bilingual performance. Some healthy bilingual subjects used code switching as a strategy but with no direct increase in the number of exemplars generated, and there was no relationship between age of acquisition, pattern of use and verbal fluency scores. In comparison, persons with Alzheimer's disease did not make use of code switching strategies, and there was some relationship between age of acquisition, pattern of use and verbal fluency scores.

Meguro, et al., (2003) assessed confrontation naming, oral reading ability, vocabulary comprehension (matching words and drawings), and written lexical decision using Western Aphasia Battery (WAB) in four persons with AD (Alzheimer’s disease) who were fluent in both Japanese and Portuguese before developing AD. The Results demonstrated impaired naming ability in both the languages. Oral reading ability was most impaired in the case of Kanji, followed by irregular words in Portuguese. They could recognize and pronounce Kana perfectly, and regular Portuguese words almost perfectly.

Bialystok, Craik, & Freedman (2007) analyzed the clinical records of 211 people who had been diagnosed with probable Alzheimer’s from the Sam and Ida Ross Memory Clinic at Baycrest over a two-year period. Among them, 102 persons were identified as bilingual and 109 as monolingual. An evaluation of them revealed that those who spoke two languages had been diagnosed with Alzheimer’s 4.3 years later and reported the start of symptoms five years later than patients who spoke only one language.

McMurtray, Saito, and Nakamoto (2009) described two bilingual persons with DAT who regressed to the use of their primary language before developing symptoms of dementia. These persons underwent general physical and neurological examinations, blood tests for treatable or reversible causes of cognitive impairment and neuropsychological testing. The two bilingual persons demonstrated poor performance on the MMSE and tests of verbal memory and visuospatial constructions. They also showed poor performance on delayed recognition of word list items resulting from increased frequency of false positive responses, possibly related to decreased self monitoring. The
bilingual patients did not demonstrate significant impairment on measures of attention, mental control, frontal executive functions or calculations.

It is evident that there are very few researches done in the area of discourse in the Indian context. Discourse abilities in persons with dementia are very less explored. And there are very less published researches in Indian scenario. Literature in this area is briefed below.

2.10 Indian studies on dementia.

Mahendra and Karanth (1996) designed a language test in Hindi to differentially diagnose Dementia from Aphasia. The tool consisted of real object naming, picture naming, generative naming, word association test, picture card sequencing and delayed story recall, and descriptive discourse. The results indicated that the test designed on the whole was very sensitive in detecting the language performance differences healthy elderly and persons with Alzheimer’s dementia. Real object naming, word association and discourse related tasks differentiated persons with dementia from Aphasia.

Thomas and Goswami (2008) verbal perseveratory and anticipatory errors in persons with Alzheimer’s disease as compared with healthy elderly. The study included three categories of clinical participants (mild, moderate and severe Alzheimer’s disease). They included four tasks, general conversation, confrontation naming, generative naming and picture descriptions. Persons with AD obtained higher percentage of perseveratory as compared to healthy participants. Generative task and general conversation were found to be potential tasks to elicit perseverations in both the groups. Picture naming task obtained lower scores as compared to object naming. There was an obvious and statistical difference in frequency percentage of perseveratory errors in persons with Alzheimer’s disease.

Sunil, Carmel and Shyamala (2008) language and cognitive deficits associated with MID and to profile the language deficits in MID. The subject was assessed on Cognitive Linguistic Assessment Protocol in Kannada, Linguistic Profile Test in Kannada, Revised Token Test and Western Aphasia Battery in Kannada. The subject
exhibited deficits like word finding difficulty, reduced mental abilities, and syntactic deficits, deficits in executing verbal commands like confusion of colors, sizes and objects.

Deepa, Sudheer and Alladi (2008) described the ability of persons with five types of dementia with mild cognitive impairment. Language screening, cognitive assessment using Addenbrooke’s cognitive examination revised, Rey Auditory verbal learning test, Rey Complex figure test, along with discourse data were gathered on picture description and narration tasks. Samples were analyzed under different discourse components. As a result, persons with mild cognitive impairment had significantly reduced cognitive skills in terms of attention and orientation, memory, visuospatial skills and language fluency. Their communication was disturbed by reduction of essential information, and impaired coherence and tangential and preservative language, despite increased verbal output. Whereas, MCI showed many impairments of object naming or identity, that could be explained completely in terms of plain naming difficulties. Speech output may be empty or non-meaningful and little information is conveyed, reflecting reduced use of precise terms and increased use of broad general terms.

Sunil and Shyamala (2009) aimed at developing a test battery in Kannada to assess persons with dementia. The test battery included four domains such as, memory, linguistic expression, linguistic comprehension, and visuospatial construction skills. The battery was administered to 30 healthy elderly and 10 persons with dementia. Performance of persons with mild dementia was near normal in most of the subtests which included, spontaneous speech, reading comprehension, following commands, etc. Persons with moderate dementia exhibited difficulty in tasks related to working memory, episodic memory, picture naming, generative naming, and generative drawing. Persons with severe dementia failed to attempt to any of the tasks due to the poor spontaneous speech output.

Rupela, Alladi, Santhoshi, Sireesha, Shailaja and Kaul (2010) investigated verbal fluencies in persons with AD in their first and second languages. Their performance was compared with that of age, gender, education and language proficiency matched
neurologically normal adults. There was a decline in the fluencies in persons with AD when compared to neurologically normal adults. However, there were no differences observed in both the groups between phonemic and semantic fluencies. There was a strong effect of language on category. No differences were found between L1 and L2 for the phonemic fluency task and all the living things categories. A higher number of words were generated in L2 (English) for all categories of non-living things. The authors have suggested testing the category of wild and domestic animals in order to test fluencies in bilingual Telugu or Hindi and English speaking participants.

Chitnis, Chaudhary, Bhan, Alladi and Rupela (2010) investigated verb naming in individuals with semantic dementia in comparison with neurologically normal participants. Persons with semantic dementia named fewer verbs correctly when compared to normal participants. The study showed that persons with semantic dementia do not show any differences in performance between transitive and intransitive verbs. Repetition and semantic cues were not very effective in eliciting names of verbs in Telugu and English among the participants with semantic dementia. They have difficulty in verb naming in L2 (English) than in L1 (Telugu). Lexical-semantic errors were seen in both Telugu and English among persons with Semantic dementia.

Anusha and Shivashankar (2010) aimed at profiling auditory comprehension deficits in a total of 103 persons with dementia (Alzheimer’s disease, fronto-temporal dementia, vascular and mixed dementia). Auditory comprehension abilities were evaluated using Linguistic Profile Test and Revised Token Test. The performance of persons with dementia were significantly poorer than healthy elderly at the linguistic levels such as, phonology, syntax and semantics and their performance deteriorated significantly with advancing disease. No significant gender differences were observed in the normal as well as dementia groups. The qualitative analysis did not reveal any significant differences in the performance between the different types of dementias.

Hence the review of studies in the area of dementia described the qualitative and quantitative aspects of discourse both in monolinguals and bilinguals. It is inferred from these studies that there is quantitative reduction in the speech of PWD as compared to
healthy elderly. The studies related to dementia in bilinguals, have concentrated on communication styles (code mixing/ code switching) in them and reported the occurrence of symptoms of dementia in monolingual as against to bilinguals. But, there are hardly few studies rather no studies which have compared the quantitative and qualitative aspects of L1 alone in monolingual and bilingual persons with dementia considering the lexical borrowing from L2 as normal or typical. In other words how well bilinguals are able to compete for conversation task as compared to monolinguals in their L1 has not been studied.