LEXICAL ACCESS IN PERSONS WITH REMITTING-RELAPSING MULTIPLE SCLEROSIS

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CERTIFICATE

This is to certify that this dissertation entitled "Lexical Access in Persons with Remitting-Relapsing Multiple Sclerosis" is a bonafide work submitted in part fulfillment of degree of Masters of Science (Speech-Language Pathology) of the student Registration Number: 16SLP032. 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.

Mysuru
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CERTIFICATE

This is to certify that this dissertation entitled "Lexical Access in Persons with Remitting-Relapsing Multiple Sclerosis" has been prepared under my supervision and guidance. It is also being 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 “Lexical Access in Persons with Remitting-Relapsing Multiple Sclerosis " is the result of my own study under the guidance of Dr. Swapna N, Reader in Speech Pathology, Department of Speech-Language pathology, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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"The single greatest cause of happiness is gratitude."

--- Auliq-Ice.

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CHAPTER I

Introduction

Communication skills have immense importance in the history of mankind. In the modern society, there is enormous social pressure on human communication skill at all stages of life. Speech and language are the two important components of human communication. They involve learning and using a code, retrieving a linguistic unit, organizing and further processing; all of which require cognitive abilities.

The relation between language skills and cognition is complex and can be dated to evolutionary changes in language from primates and involvement of cognition in such developmental changes. The cognitive skills required for successful communication were already in place even before the evolution of social communication (Seyfarth & Cheney, 2015). Thus communication results from the interaction between cognition and language. Language is one of the most complex cognitive tasks and includes simple activities such as naming to comprehending and speaking complex language forms like metaphors. The cognitive processes shape the use of language skills for communicative function.

As language is a by-product of cognition, any subtle changes in domains of cognition due to different neuropathological conditions can directly influence language. Multiple sclerosis is one such condition that can affect language either due to lesion in language zone or due to a cognitive decline.

Multiple sclerosis (MS) is a neurodegenerative disease which results from damage to the white matter. The disease mainly affects axonal conduction through the white matter pathway, which is caused by demyelination due to inflammation. MS is usually described as disease of unknown etiology, but there are a few reports of MS that states that it is caused by genetic, environmental or infectious factors (Ascherio & Munger, 2007). The age of onset of the disease can range from 20 to 40 years. The disease is most common in North Europe and United States, with females being more affected than males (Scolding & Wilkins, 2012). MS can be grouped into four types based on the course and recovery patterns, which are, clinically isolated syndrome, Relapsing-Remitting MS, Primary Progressive MS and Secondary Progressive MS (Pérez, 2016).

Persons suffering from MS manifest a wide range of disabling deficits, which may include speech, motor, psychological, sensory or cognitive linguistic functions. The symptoms within the group vary widely depending on the duration of disease, course of disease and severity (Pérez, 2016). This range of disabilities limits their social participation and quality of life.

MS has been long understood and studied as a disorder of speech production; however the recent past has seen a growing rise of interest among researchers to study the cognitive-linguistic functions. The involvement of language depends on anatomic location of lesions. Language impairment has been viewed with controversies in the past, with investigators suggesting that, it may also result from an underlying cognitive impairment.

Cognitive impairment in persons with MS has been reported by Charcoat as early as in 1877, however extensive exploratory studies on cognitive functions in persons with MS have been done only in the recent past. Deficits involving information-processing speed, verbal

fluency, problem solving, and recall measures of anterograde and remote memory were observed (Beatty, Goodkin, & Monson, 1989). Foong, Rozewicz, Quaghebeur, Davie, Kartsounis, Thompson, and Ron (1997) studied executive functions in 42 persons with MS using a neuropsycholgical battery and a fMRI paradigm and found no specific lesion site for the impairment in executive function. Thornton, Raz, and Tucker (2002) reported deficits in memory encoding and integration. Nelson, Akhtar, Zuniga, Perez, Hasan, Wilken, and Steinberg (2016) recently reported correlation between the working memory and prefrontal lobe activation in persons with MS. A study by Sepulcre, Peraita, Goñi, Arrondo, Martincorena, Duque, Mendizábal, Masdeu, and Villoslada (2010) reported a general cognitive decline in 45–60% of MS patients. Trenova, Slavov, Manov, Aksentieva, Miteva, and Stanilova (2016) reported cognitive dysfunctions is present in 75% persons with MS and affects quality of life in persons with MS.

Frequently reported language problems in MS vary from specific type of aphasia (Beatty, Goodkin, & Monson, 1989; Laatu, Hämäläinen, Revonsuo, Portin, & Ruutiainen, 1999; Lacour, De Seze, Revenco, Lebrun, Masmoudi, Vidry, & Vermersch, 2004; Demirkiran, Özeren, Sönmezler, & Bozdemir, 2006) to specific impairment in lexical access. The most frequently reported difficulty was impaired word retrieval in verbal fluency tasks. These are tasks that heavily depend on executive functions and this shows that the language impairments in MS result from cognitive dysfunction rather than language deficits (Renauld, Mohammed-Said, & Macoir, 2016).

In order to produce and understand language, an individual must have some form of cognitive representations of the words in their language and the ability to access such representations rapidly. This pool of mentally stored information is called lexical memory or the

mental lexicon, and the retrieval of such information is referred to as lexical access (Ulahannan, Shah, Cader, & Nair, 2016). A lexicon has been defined as mental encyclopedia, which includes not just a word, but all general and specific information, both linguistic and non-linguistic aspects of that word. More specifically, the mental lexicon consists of information about the word and concepts, different concept links between the words and also the pronunciation of words (McCormick & Schiefelbush, 1984). According to Yelland (1994), mental lexicon of any single word would contain the person's knowledge about syntactic and semantic properties of the particular word. On the other hand, the lexical access involves the retrieval of words from mental lexicon which include processes such as encoding, search and retrieval (Forster, 1976). Lexical access involves many cognitive processes such as memory and attention. Lexical access is commonly assessed using tasks such as confrontation naming, verbal fluency, word definition, open-ended questions, semantic description, word recall, word recognition, category verification and lexical decision (Abhishek & Prema, 2016).

Lexical access is an early and frequent symptom in persons with MS which depend on cognitive flexibility and information retrieval (Sepulcre et al., 2010). Studies in the past have investigated the lexical access abilities in persons with MS using various investigation procedures which include, confrontation naming, semantic and verbal fluency. Of the three, the most commonly reported were semantic and verbal fluency. According to Henry and Beatty (2006), verbal fluency may be amongst the most sensitive neuropsychological measure to assess cognitive impairment in MS, among which phonemic and semantic fluency have been affected the most.

Studies have been conducted to assess the lexical access in persons with MS predominantly using verbal fluency tasks. Beatty and Monson (1990) studied lexical access in

persons with MS using tasks such as confrontation naming, lexical priming (relatedness and free-association test) and verbal fluency and found that persons with MS obtained better scores on confrontation naming and lexical priming than on verbal fluency.

Sixty persons with MS were studied by Lethlban and Murdoch (1994) using Boston naming test (BNT, Goodglass, Kaplan & Weintraub, 1983) and found that persons with MS had more semantic errors than perceptual errors implying lexical access difficulties in persons with MS. Oliver, Nieto, Sánchez, Wollmann, Hernández, & Barroso (2005) conducted tests on lexical access in persons with MS using BNT and controlled oral word association test (COWAT, Benton & Hamster, 1976) and found both control group and clinical group performed similar in all the tasks. Bensa, Bertogliati, Chanalet, Malandain, Bedoucha and Lebrun (2005) studied 32 persons with MS considering the duration of disease less than 5 years and found that no significant naming impairment or verbal fluency deficits were present.

Thirty Farsi-speaking young adults with MS and age and gender matched healthy controls were assessed for verbal fluency and semantic fluency using three categories for semantic fluency and three letters for phonemic fluency (Ebrahimipour, Shahbeigi, Jenabi, Amiri, & Kamali, 2008). They found that there was a significant difference between the two groups. They related the poor performance of persons with MS in verbal fluency tasks to a cognitive impairment. The authors also postulated that the difficulty in verbal fluency in persons with MS was due to difficulties in processing the information presented at a rapid rate and accessing words from lexicon for verbal expression and formulating language.

Tallberg and Bergendal (2009) studied 25 persons with MS using Confrontation naming and verbal fluency with 25 age matched healthy individuals. The substitution patterns in

Confrontation naming and lexical strategies in verbal fluency were explored. It was found that persons with MS had more off-target substitution in confrontation naming and lexical access strategies in verbal fluency were also affected. The authors correlate these lexical access difficulties and semantically distinct substitution to cognitive decline.

Forty five participants with all types of MS (clinically isolated syndrome, relapsing remitting; secondary progressive and primary progressive)were included in a longitudinal study of lexical access abilities and were tested on Boston Naming test and verbal fluency (phonemic fluency and semantic fluency) which included measuring the clustering and switching (Sepulcre et al., 2010). The participants were also classified based on the cognitive impairment, either with cognitive impairment or with no cognitive impairment. Semantic fluency, switching in phonemic fluency, switching in semantic fluency and the Boston Naming test had a significant difference between the study group and control group. Within group comparison was made and was found that after two years of disease course, there was a significant decline in switching in semantic fluency and cluster size in semantic fluency. Thus the authors concluded that participants with MS have greater difficulty with cognitive flexibility and retrieval rather than in the lexicon size.

In a recent study, fifteen persons with remitting-relapsing MS performed poor compared to age and gender matched healthy controls in confrontation naming measured using Boston Naming test and in spontaneous speech and repetition tasks tested using Western Aphasia Battery. Many other domains such as listening comprehension, making inferences, oral expression (recreating sentences), semantic absurdities and definitions were also found to be significantly poor in persons with MS when compared to healthy controls (Barwood & Murdoch, 2014). The authors correlated the significant findings in spontaneous speech, naming and repetition to the deficits in sentence organization and lexical retrieval. The authors in specific,

attributed the lexical-semantic processing difficulties in MS to the decline in cognitive functions especially memory, and the naming impairments to the deficits in lexical access, semantic organization and visual perception. They concluded that the naming difficulties were due to the inability to retrieve words from mental lexicon and not due to breakdown in knowledge of the lexicon as seen in dementia. Perez (2016) also attributed presence of difficulty in picture naming and verbal fluency to lexical semantic processing difficulties rather than retrieval of words from the lexicon.

In a meta-analysis (Renauld et al., 2016) on studies which focused on lexical access in persons with MS, it was found that language impairments occurred less frequently and cognitive functions such as executive functions were the most commonly affected. Out of the language aspects affected, word retrieval in verbal fluency was the most common deficit as it involved set switching and inhibition.

Ebrahimipour, Weisi, Rezaei, Motamed, Ashayeri, Modarresi, and Kamali (2017) studied lexical access abilities in 90 Persian speaking persons with MS using tasks such as semantic fluency, phonemic fluency, and homophonic meaning generation. The authors found that the persons with MS performed poorer when compared to the control group in semantic fluency, phonemic fluency, and homophonic meaning generation. They also calculated the cluster size and switches for both semantic fluency and phonemic fluency and found that persons with MS had poor scores than the control group in switching strategy. They did not find a significant difference between the groups in the clustering strategy. The authors concluded that in persons with MS, lexical access is affected and not the lexical knowledge since the switching strategy required intact lexical access abilities for better performance and clustering strategy requires intact lexical knowledge.

1.1 Need for the study

An extensive review of the existing literature revealed that though predominantly MS is known to cause motor speech impairment, a few studies have been conducted in the recent past, to assess the cognitive and linguistic impairment. A process, which is very essential for communication, that involves both cognitive and linguistic aspects, is the lexical access. Most studies have related these lexical deficits to cognitive functions such as memory and attention (Foong et al., 1997; Thornton et al., 2002; Langdon, 2011, Trenova et al., 2016). It was also found that even participants with mild cognitive impairment had difficulties with lexical access (Sepulcre et al., 2010). However Bensa et al. (2006) reported that though the participants had cognitive impairment, they did not present with verbal fluency and naming deficits. Thus the findings with respect to the relationship between cognition and lexical access in the literature are inconsistent.

It has been also found in the literature that the lexical knowledge is less affected when compared to lexical retrieval, which were studied using strategies such as clustering and switching. The results of most studies in the literature have shown that tasks such as switching and clustering are the two main areas affected. The authors have concluded that switching strategy is more affected than clustering and hence lexical access was affected rather the lexicon (Lethlean & Murdoch, 1994; Ebrahimipour et al., 2008; Tallberg & Bergendal, 2009; Barwood & Murdoch, 2014; Renauld et al., 2016).

These subtle deficits in language are reported to be underestimated. Though lexical access which is a way of examining such subtle changes and reported to be affected, it has been investigated by only few researchers they have been underestimated and not studied extensively. These deficits go unnoticed with disease course and are neglected in conventional psychological

and linguistic assessment. In the recent past, however, there has been greater interest rooting in the involvement of subcortical pathways in language and there have been studies reporting impaired language skills in patients with atrophy in subcortical structures and white matter pathways (Friend, Rabin, Groninger, Deluty, Bever, & Grattan, 1999; Laakso, Brunnegard, Hartelius, & Ahlsen, 2000). Hence there is a need to explore cognitive-linguistic processes such as lexical access in persons with MS. The examination of the lexical access would provide an insight into the cognitive processes such as memory, attention and information processing speed, which are reported to be most impaired in MS.

Lexical access ability is the most commonly affected domain in MS and is an exhaustive way of examining subtle language changes. Lexical access, in the past, has been most commonly studied using tasks such as verbal fluency and confrontation naming. However, tasks such as superordinate, coordinate and generative naming which are more complex have rarely been used to study the lexical access. Beeson, Holland, and Murray (1995) reported that coordinate naming was difficult even for neuro-typical individuals. According to Bayles (2003), generative naming required more cognitive demands than generative naming. Hence generative naming has been reported to identify even mild forms of dementia (Bayles & Tomoeda, 1983). Superordinate naming was also found to be difficult for persons with aphasia since it involved two processes, one was to determine the class relations between various names presented and other, to determine the superordinate category (Beeson et al., 1995). Thus it is interesting to study whether persons with MS perform differentially across different naming tasks.

Further, studies assessing lexical access in persons with MS in the Indian context are limited. It is important to study these across languages as cognitive linguistic functions vary. For instance, Rosselli, Ardila, Salvatierra, Marquez, Luis, and Weekes (2002) studied verbal fluency

in 82 English and 82 Spanish speaking healthy individuals and found that there was a significant difference between the groups in phonemic fluency tasks. Keeping these aspects in view, the present study was planned with the aim of investigating the lexical access in persons with MS.

1.2 Aim of the study

The aim of the present study was to investigate the lexical access abilities in Tamil speaking persons with remitting-relapsing MS using a range of naming tasks. The specific objectives of the study were as follows:

- To compare the lexical access abilities in persons with remitting-relapsing MS with healthy controls.
- To compare lexical access within the persons with MS, considering factors such as duration of disease and cognition.

1.3 Hypothesis

1. There was no significant difference in the performance of healthy controls and persons with remitting-relapsing MS in lexical access.
2. There was no significant correlation between disease duration and lexical access abilities in persons with remitting-relapsing MS.
3. There was no significant correlation between cognitive abilities and lexical access abilities in persons with remitting-relapsing MS.

CHAPTER II

Review of Literature

2.1 Multiple sclerosis

Multiple Sclerosis (MS) is a chronic, degenerative, demyelinating, inflammatory disease of the central nervous system, which predominantly affects the white matter of the brain. The disease affects the axonal conduction through the white matter pathways. The areas of inflammation and swelling are called plaques which are formed by demyelinated axons and the dead oligodendrocytes. The demyelination usually involves the periventricular areas, white matter tracts of brainstem, optic nerves, spinal cord and less commonly the mylineated fibers of gray matter (Pérez, 2016).

2.1.1 Cause and pathophysiology of MS

The cause of MS is not yet well defined, though factors such as immune system response to some virus, environmental, and genetic factors have been attributed. The infectious cause that can be related to MS is the Epstein–Barr virus (EBV), which causes MS as result of body's immune system response. The effect of the virus varies with environmental factors such as toxins, nutrition (Vitamin D) or infections (Ascherio & Munger, 2007). According to Pérez (2016) the genes that are involved in MS were "HLA-DRB1" (human leucocyte antigen) and "IL7R" (interleukin 7) receptor alpha chain.

The dominant feature in MS is the demyelination, which in turn leads to blocks in the neural conduction pathways. Microscopic studies of normal appearing brain tissues have shown that there were inflammations, gliosis (scarring), and myelin damage (Smith & McDonald, 1999). The other microscopic changes include microglia activation, oxidative injury and energy

deficiency due to mitochondrial damage which leads to the inflammation and neurodegeneration of cells. The demyelination and neural inflammation are more evident in periventricular white matter, which extends to juxta-cortical white matter areas (Haider, Zrzavy, Hametner, Hoftberger, Bagnato, Grabner, Trattnig, Pfeifenbring, Bruck, & Lassman, 2016). The hippocampal demyelination leads to reduction in expression of neuronal proteins which are reported to be important in axonal transport, synaptic plasticity, glutamate homeostasis, memory/learning and neuronal survival. These changes in turn result in cognitive impairment (e.g. memory loss) in persons with MS as hippocampus is involved in storage and retrieval (Dutta, Chang, Doud, Kidd, Young, Fox, Staugaitis, & Trapp, 2011). These changes are caused by adaptive changes and response of innate immune mechanism to T-cell mediated inflammation.

Cerebellum has been found to be affected in 80% of persons with MS resulting in ataxia. The most common site of lesion was found to be the cerebellar peduncles. Cerebellum was also found to take part in cognitive processing in tasks such as verbal fluency, attention and working memory. Intracortical lesions of cerebellum are more common in MS which involves majority of gray matter. Pathologies like reduction in the density of purkinje cells were also found in cerebellum. Cerebellar volumes were also found to be reduced in persons with MS (Wilkins, 2017).

Language disorder seen in persons with MS are reportedly due to inflammation in the enormous subcortical structure and frontal lobe especially in the operculum, prefrontal cortex, specifically in the inferior frontal gyrus (pars opercularis and pars triangularis) and the middle frontal gyrus (Barwood & Murdoch, 2014). Some researchers have also reported the lesion sites

in invaginations of the cortex such as sulci, cingulated cortex and insular cortex (Haider, et al. 2016).

2.1.2 Course of MS

Two stages of MS have been reported which include, a period of inflammation of cells which occur early in the disease course, and a second stage, which includes a period of degeneration/cell death leading to long term deterioration of functions (Rog, Burgess, Mottershead, Talbot, & Robinson, 2010). The course is unpredictable; in about 2/3rd of the patients with MS, the symptoms come and go spontaneously, with relapse (period of inflammation caused due to demyelination) and remissions (recovery from inflammation due to remyelination). The period between relapse depends on the body's repair system. In the remaining 1/3rd, the course is progressive (Charcot, 1877).

MS is usually classified into four types, namely, (a) clinically isolated syndrome, (b) remitting-relapsing, (c) secondary progressive and (d) primary progressive. The first manifestation of the symptoms is usually diagnosed as clinically isolated MS, where inflammatory demyelination is present, but does not fulfill the diagnostic criteria of MS. If clinically isolated syndrome of MS remains active and meets the criteria for diagnosing MS, based on MRI and other clinical test findings, then these subjects are diagnosed with remitting-relapsing MS. The remitting relapsing type of MS would show either complete recovery after a period of relapse or incomplete recovery with residual deficits. If the remitting-relapsing type of disease begins to progress into worse neurological accumulatory processes, after a period of relapse and remissions, then it is diagnosed as secondary progressive type. However, the imaging or pathological data which defines the transition from relapsing condition to progressive is not yet well defined (Lublin, Reingold, Cohen, Cutter, Thompson, Sorensen, Thompson, & Bebo,

2014). Factors such as severity of signs and symptoms, frequency of relapses, rate of worsening, residual disability, and impairment are being used to differentiate remitting-relapsing from progressive disease course. Annual imaging studies would further enhance the differentiation as progressive disease would remain relatively stable over a period of time. If the disease begins with progressive neurological lesions without any remissions in the initial stages, then they would be diagnosed as primary progressive type MS.

The diagnosis of MS is based on McDonald's Criteria (Polman, Reingold, Banwell, Clanet, Cohen, Filippi, & Lublin, 2011) according to which the diagnosis should be based on the Magnetic resonance imaging (MRI) where the lesion should be disseminating in space and time, and cerebrospinal fluid which should consist of oligodendrocytes bands.

2.1.3 Incidence and prevalence of MS

The prevalence of MS is on an average 30 per 100,000; Europe with the highest prevalence (80 per 100,000), followed by the Eastern Mediterranean (14.9), the Americans (8.3), the Western Pacific (5), South-East Asia (2.8), and Africa (0.3) (Atlas, 2008). In the various regions of India, based on hospital data, it has been suggested that the prevalence of MS is about 0.17 to 1.33 per 100,000 of population. When compared to West, the "remitting-relapsing type" is reported to be more prevalent in India (Singhal & Adyani, 2015). The age of onset of MS is usually in the fourth decade of life which is between 20 and 40 years of life; 5% of cases have been reported with childhood onset and it is rarely diagnosed after 70 years of age. Across ethnicity, the female to male ratio of MS is 3:1 (Scolding & Wilkins, 2012).

2.1.4 Salient characteristics of MS

MS usually encounters diverse spectrum of clinical manifestations, due to diversity in plaque location, which can be highly disabling. This includes motor weakness, in-coordination in the upper limbs usually intentional tremor, acute unilateral retrobulbar neuritis, nystagmus, cerebrospinal fluid abnormalities, dysarthria which is either spastic or ataxic and aphasia (Brain & Walton, 1969).

Persons with MS might encounter optic neurititis in early stages of disease which is almost experienced by more than half of this population. They might also develop color discrimination difficulties and hemianopia in later stages of the disease. Other visual impairments seen commonly in MS are internuclear ophthalmoplegia, nystagmus, oscillopsia (stationary objects appear to be moving), blurred vision and vertigo (Baril, 2011).

Persons with MS can also present with auditory processing deficits, which plays a key role in processing information for cognitive tasks. There have been reports that though persons with MS have normal pure tone thresholds; their central auditory processing is affected. Valadbeigi, Weisi, Rohbakhsh, Rezaei, Heidari, and Rasa (2014) studied 26 persons with MS who had normal pure tone threshold using gap in noise test, duration pattern sequence test and word discrimination score. The authors found that the participants in MS group had obtained poor scores on tests for central auditory processing. The authors concluded that the persons with MS had difficulty in central auditory processing involving processes such as temporal resolution, auditory pattern, auditory memory and speech discrimination in noise.

Impairment of muscles is another salient feature associated with MS. They include stiffness, weakness and spasms which reduces the muscle's functional ability of the person.

Weakness of limbs is present in almost 80% of all persons with MS. Either the lower limbs or only one of the lower limb is usually affected. Limb weakness can also result from tremor, cerebellar ataxia which may in turn lead to loss of postural sense. Spasticity associated with limbs is also found among persons with MS and studies have reported that spasticity is the most common cause for inability to work in persons with MS. Ataxia and tremors associated with them are present in almost 75% of persons with MS and are mostly present in upper limbs unlike spasticity and weakness which is present in lower limbs (Johnston & Joy, 2011).

MS involves various functional subsystems of the body, as it does involve the speech subsystem too. Speech impairment is one of the vital features of MS, referred to as "scanning speech" (Darley, Brown, & Goldstein 1972). Darley et al. (1972) studied 168 individuals with MS and reported that 41% displayed deviant speech performance, whereas 59% had near normal speech production. Beukelman, Kraft, and Freal (1985) proposed that 23% of 656 individuals report speech and other communication deficits as a symptom of MS. According to the National Multiple Sclerosis Society (2000), almost 25-40% of the people with MS exhibit speech deficits. A study by Murdoch and Theodoros (2000) concluded that the prevalence of mild to severe dysarthria in individuals with MS was 51% and this compromised all components of speech production: respiration, phonation, oral motor performance, articulation, prosody, and intelligibility. Dysarthria associated with MS has been characterized as spastic or ataxic. This classification is primarily based on the combination of auditory-perceptual characteristics and the site of lesion (Darley, Aronson, & Brown, 1969; Darley, Aronson, & Brown, 1975).

Most individuals with MS show a progressive decline in speech intelligibility as the disease progresses (Farmakides & Boone, 1960). Most speech deviations become more pronounced as additional systems get involved. Hartelius, Runmarker, and Andersen (2000)

reported a positive correlation between the deviations present in the speech production to the overall severity of the neurological involvement, type of disease course, and the duration of the disease in MS. However, Darley, Brown, and Goldstein (2016) stated that speech impairment was not related to age of the patient or the duration of illness, but it was positively correlated to the severity of the neurological involvement.

Fatigue is another common symptom associated with MS, which can either physical or cognitive fatigue. Depression occurs in more than half of persons presenting with MS, which may be associated with cognitive deficits or medications (Pérez, 2016). Other psychological symptoms such as demoralization which might include distress, helplessness, subjective incompetence, loss of self-esteem, and alienation and deterioration in relationship have also been reported. These symptoms were self reported by the participants (Mohr, Dick, Russo, Pinn, Boudewyn, Likosky, & Goodkin, 1999). Health related quality of living (HR-QOL) studied in MS revealed that the psychological factors such as coping, mood, self-efficacy, and perceived support determine HR-QOL rather than the biological symptoms such as muscular weakness or fatigue (Mitchell, Benito-León, González, & Rivera-Navarro, 2005).

2.2 Cognitive deficits in MS

MS being studied predominantly as a disorder of speech may also cause significant impairment in cognitive abilities as reported in a few studies, which is usually independent of physical impairment. Though cognitive impairment is viewed independent of physical impairment, it progresses with increasing disease duration (Trenova et al., 2016). A study by Sepulcre, Peraita, Goñi, Arrondo, Martincorena, Duque, Mendizábal, Masdeu, and Villoslada (2010) reported a general cognitive decline in 45–60% of MS patients. A recent study by Trenova, Slavov, Manova, Aksentieva, Miteva, and Stanilova (2016) reported that cognitive

impairment appeared in about 75% of persons with MS at any stage of the disease. They postulated that cognitive deficits in remitting relapsing MS resemble subcortical dementia. Several others authors have also reported deficits in cognitive aspects such as information processing speed, memory, executive function, visual perception, attention and working memory (Langdon, 2011; Trenova et al., 2016).

Cognitive deficits are one of the early symptoms that persons with MS present with, as a part of a wide variety of other impairments and such cognitive impairment can also lead to symptoms like depression. Several factors such as duration, extent of lesion, lesion in the cortical and subcortical structures determine cognitive deficits in MS. With development of clinical assessment tools and growing literature, cognitive impairment has become a markedly defining characteristic of MS. The persons with MS exhibit deficits in memory, decision making, distractibility, verbal memory, visuospatial perception and speed of information processing when handling different information (Perez, 2016).

The most commonly reported cognitive deficits in persons with MS are executive functions and memory. In this line, executive functions were studied in a systematic way in 42 persons with MS which also was correlated with the frontal lobe lesions using an fMRI paradigm Foong et al., 1997). A neuropsychological test battery was used which included verbal fluency, progressive matrices, stroop test, spatial span test, spatial working memory, and planning test to assess executive function. The investigators found that persons with MS had difficulty in executive functions which was attributed to frontal lobe pathology. The cognitive difficulty was attributed to wide spread lesions rather than focal lesions.

Thornton and colleagues (2002) explored memory deficits in persons with MS using encoding specificity paradigm. They studied 14 persons with MS and age matched healthy controls using 60 word pairs, with cues strongly or weakly associated with the target word. The first fifteen words were presented with cues which were presented previously and next fifteen words were presented with new associates. The authors found that persons with MS exhibited more difficulty in retrieval of words from long term memory when weakly associated with contextual cues. Thus they were less effective in integrating cues or encoding during the process of retrieval.

Trenova et al. (2016) reported the cognitive deficits in persons with MS based on a literature review. On an average, the authors report that 75% of persons with MS have cognitive impairment. The authors state that various factors such as intelligence, age, disease duration, disease type, site of lesion, affect the cognitive decline in person with MS. The authors had also report that persons with remitting-relapsing MS had less cognitive decline than primary progressive and secondary progressive. The cognitive decline was also associated with the extent of brain atrophy and exact site of lesion. Based on the literature review on studies which examined cognitive impairment in persons with MS, they have found that attention, executive functions, information processing, visuo-spatial perception, memory and working memory were most commonly affected domains. They put-forth that only 10-15% of persons with MS will have difficulty in storage, semantic knowledge and intelligence and these may lead to dementia. The authors have provided with several tests of cognition which are sensitive to cognitive impairment in persons with MS. They include Minimal Assessment of Cognitive Function in MS (MACFIMS, Benedict, Fischer, Archibald, Arnett, Beatty, Bobholz, & Foley, 2002); Brief Repeatable Battery of Neuropsychological Test (BRBNT, Rao, 1990); Repeatable Battery for

Assessment of Neuropsychological Status (RBANS, Randolph, 1998); Screening Examination for Cognitive Impairment (SEFCI, Beatty, Paul, Wilbanks, Hames, Blanco, & Goodkin, 1995); and Brief International Cognitive Assessment for MS (BICAMS, Benedict, Amato, Boringa, Brochet, Foley, Fredrikson, & Reder, 2012). The authors also found that the cognitive impairment in persons with MS affects their quality of living by hampering their activities of daily living such as shopping, driving and household work. Thus they conclude that due to increasing cognitive impairments in persons with MS, regular monitoring and therapeutic management is required.

Recently Nelson, Akthar et al. (2016) also correlated cognitive impairment with lesions in cerebral cortex using a working memory and fMRI paradigm. This study compared between persons with MS with no cognitive impairment and with cognitive impairment. The scores of cognitive domains, fMRI results and presence of physical disability were also correlated. They found that Blood-oxygen-level dependent (BOLD) was high in the group of persons with MS with no cognitive impairment in the prefrontal area. They also found that the memory tasks such as immediate and delayed recall were sensitive to identify the cognitive impairment in MS. They also found a correlation between the degree of disability and lesion load. The lesion load was responsible for the interference between various areas in brain and their connections, which were important for cognition. Task specific increase in activation of brain areas in the group with no impairment was seen in BOLD, from which the authors concluded that persons with MS use compensatory mechanism in order to overcome the cognitive difficulties, which would delay the development of further cognitive impairment with disease progression.

2.3 Language deficits in MS

The involvement of subcortical structures in MS paved way for immense concern among researchers to study the language processing in persons with MS. Lethlean and Murdoch (1997) studied higher language impairments in chronic MS. They investigated the relation between disease course, subcortical white matter pathways and language impairment. The study included 60 participants with MS in the age range of 26-76 years and the average duration of disease ranged from 1 to 53 years. The study included both persons with remitting-relapsing MS and chronic progressive MS. The language abilities were assessed using Test of Language Competence (TLC) (Wiig & Secord 1985) and The Word Test (TWT) (Jorgensen, Barrett, Huisingh & Zachman, 1981). The participants with MS performed poorly on all tasks when compared to the healthy participants. The performance was poor in the group with MS irrespective of the disease progression. The results also suggested that the persons with chronic-progressive MS performed poorer than the persons with remitting-relapsing MS. The participants in the MS group performed poor in vocabulary and semantic tasks of TWT that included making associations, explaining absurdities, identifying antonyms and defining words and also in subtests of TLC such as re-creating sentences and understanding ambiguous sentences. The authors correlated the findings with difficulty in parallel processing of neural modules by subcortical structures. They postulated that the higher cortical structures are involved in serial processing, whereas subcortical structures are involved in parallel processing, which is important for higher language functions.

Laakso, Brunnegard, Hartelius, and Ahlsen (2000) studied higher language functions in nine persons with MS who were divided into two groups, one who reported language difficulties and the other group included participants who did not report of any language difficulties and

were compared with healthy controls. Domains such as repetition, comprehension of logico-grammatical sentences, naming famous people, comprehension of ambiguous sentences, word fluency, recreating sentences, comprehension of metaphors, making inferences, similarities/dissimilarities and word definitions were studied using test battery constructed by the authors. The results indicated that the participants who self reported language difficulties had lower scores in domains on which they reported difficulties than the participants who did not report any language difficulties. The difficulties were more significant in subtests such as repetition, vocabulary, word definitions, ambiguities and recreating sentences. The subtests that required verbal memory functions imposed more difficulty for the participants. The authors caution interpretation based on the results as the sample size was small.

2.4 Lexical access and MS

Language is a complex and dynamic system used for social communication. Semantics is one of the components of language system which involves the organization and representation of meaning of several lexical items (words) in the lexicon. Lexical access is the way in which these lexical items which are organized in mental lexicon are accessed. Effective social communication relies on effortless flow of words which require timely access to words which is affected when there is an evident brain lesion as in case of persons with MS.

A few investigators in the recent past have investigated lexical access abilities in persons with MS considering the fact that identification of such subtle language impairment will provide insight into disease progression and aid in early intervention of higher-language impairment.

Sixty-four persons with MS (clinically isolated syndrome, relapsing remitting; secondary progressive and primary progressive) were studied by Beatty and Monson (1990) where they

compared semantic priming abilities between a group with high naming scores and a group with low naming scores. The cognitive abilities were measured using the screening examination for cognitive impairment in multiple sclerosis (SECIMS, Beatty, & Goodkin, 1990) as Mini Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975) was found to be insensitive in identifying the mild cognitive impairment in MS. The naming abilities were measured using 15-item BNT which had similar sensitivity as 60 item BNT. The authors subdivided the persons with MS into three groups, where one group consisted of subjects with normal BNT and SECIMS scores, second group consisted of subjects with low BNT and SECIMS scores and the third group consisted of subjects with low SECIMS and normal BNT scores. The study also included a control group, which consisted of 22 neuro-typical individuals who were matched for age and gender with the experimental group. The experiment involved two phases; in phase 1, the subjects were asked to rate the word pairs based on the relatedness on a 5-point rating scale and in phase 2, the subjects were shown one card from each pair and asked to name the item that first came to them as they saw them (free-association test). Despite differences in the cognitive and naming abilities, all the groups performed similarly on both the relatedness test and free association test. Thus this study revealed that the semantic memory and lexical knowledge remained intact in persons with MS whereas the lexical retrieval from the lexicon was more difficult. The authors arrived at this conclusion as the persons with MS performed better on lexical priming and also they performed better in confrontation naming than in verbal fluency tasks. However, the authors did not postulate a hypothesis on the lower scores of BNT.

Lethlban and Murdoch (1994) assessed lexical access in 60 persons with MS using BNT and compared the scores with age and gender matched healthy controls. The study included persons with MS with a disease duration ranging from 1 to 53 years with an average of

16.0±11.9 years and all disease types. They found that persons with MS obtained lower scores compared to healthy controls. The authors also found that the most common errors seen during naming tasks was semantic errors in persons with MS. Perceptual errors in naming were found in individuals with optic nerve atrophy. The authors concluded that the naming errors were due to inattention, which is common in disorders that involve subcortex.

Thirty three persons with remitting-relapsing MS with a average disease duration of 4.2 years were studied on MMSE, Wechsler Adult Intelligence Scale-Revised (WAIS-R, Wechsler, 1981), token test, BNT and COWAT (verbal fluency). It was found that the participants in the clinical group performed similar to the participants in the control group in all the tasks (Olivares et al., 2005).

Bensa et al. (2006) studied 32 persons with remitting-relapsing MS diagnosed in less than 5 years. A neuropsychological test and BNT were used in order to assess the cognitive and language functions and also an MRI was used. All the participants in the clinical group presented with memory complaints and the authors found that naming impairments were infrequent and verbal fluency deficits were not present. Cognitive domains such as executive functions, attention, memory and processing speed were affected but they found that these improved on a follow up after 2 years and hence concluded that cognitive impairments in MS are fluctuating.

Thirty Farsi-speaking young adults with remitting-relapsing MS and age and gender matched healthy controls were assessed for verbal fluency and semantic fluency using three categories for semantic fluency and three letters for phonemic fluency. They found that there was a significant difference between the two groups (Ebrahimipour, Shahbeigi, Jenabi, Amiri, & Kamali, 2008). The authors also postulated that the difficulty in verbal fluency in persons with

MS was due to difficulties in processing the information presented at a rapid rate and accessing words from lexicon for verbal expression and formulating language.

Tallberg and Bergendal (2009) studied lexical functioning in persons with remitting-relapsing MS where they studied the relation between substitutions for target words in confrontation naming with the word fluency retrieval. The authors included 25 Spanish speaking persons with MS and 25 matched controls in the age range of 9 to 41 years. The mean duration of disease was 20 years. Cognitive functions of the participants were measured using four sub-tests of WAIS and Symbol Digit Modalities Test (SDMT, Smith, 1968). The lexical access abilities were assessed using two standardized tests namely, BNT and the letter fluency test (COWAT). In addition to the mean scores for the correct responses on the two tests, the responses on confrontation naming were analyzed for semantic closeness (semantic specificity, off-target and semantic un-specificity) of substituted word to the target word. The responses in word fluency were calculated for cluster size and switches between the clusters were also calculated. The results indicated that the persons with remitting-relapsing MS substituted semantically distant and off-target responses during the confrontation naming task. The results also indicated that scores of the clinical group were significantly lower than the control group in terms of total number of words produced and number of switches. The authors also found a positive correlation between performance in cognitive tests and scores in BNT and COWAT in both clinical and control group. A correlation of switching performance in COWAT with unspecified responses and off-target responses in BNT was also found by the authors. With these results, the authors concluded that poor lexical access abilities are associated with the cognitive decline in domains such as executive functions. The cluster size obtained from word fluency tasks was normal and hence the authors also concluded that the lexical knowledge is well

preserved in persons with remitting-relapsing MS**.** Thus these individuals have difficulty only with lexical access, as switching strategies were affected, which requires cognitive functions such as executive functions and low processing speed. The authors also postulated that the poor substitution abilities observed can affect the quality of life of the persons with remitting-relapsing MS. The authors hypothesized that decline in lexical processing is hierarchical as language forms which were learnt were first to be lost.

Forty five participants with MS were included in a longitudinal study of lexical access abilities and were tested on BNT and verbal fluency (phonemic fluency and semantic fluency) which also included measuring the clustering and switching (Sepulcre et al., 2010). The mean age range of the participants was 36.56 years and they all had 6 years of average disease duration. The participants included in this study had last relapse within previous 3 months. The participants were evaluated regularly for the disease progress in the 2 years using interview and neurological evaluation. The participants who had normal scores in Boston Diagnostic Aphasia Evaluation (BDAE, Goodglass, Kaplan, & Barresi, 2001) test were only included for the study and were also classified based on the cognitive impairment, either with cognitive impairment or with no cognitive impairment. The cognitive impairment was assessed using The Spanish validation of the Brief Repeatable Battery– Neuropsychology (BRB–N; Sepulcre, Vanotti, Hernandez, Sandoval, Caceres, & Garcea, 2006) and lexical access abilities were assessed using semantic (animals) and phonemic (letter p) 90-second fluency tasks and the BNT. Semantic fluency, switching in phonemic fluency, switching in semantic fluency and the BNT had a significant difference between the study group and control group. Within group comparison was made and was found that after two years of disease course, there was a significant decline in switching in semantic fluency and cluster size in semantic fluency. The authors also found that

even persons with MS who had mild cognitive impairment had lexical access difficulties. Thus the authors concluded that participants with MS have more difficulty with cognitive flexibility and retrieval rather than in lexicon size, which is consistent with findings of the previous study. They also speculated that the lexical access abilities also decline in persons with MS just like other impairments, in physical and global related measures.

In a recent study, fifteen persons with remitting-relapsing MS aged 42–72 years with a disease duration ranging from 7-29 years performed poor compared to age and gender matched healthy controls in confrontation naming measured using BNT and in spontaneous speech and repetition tasks tested using Western Aphasia Battery (WAB, Kertez, 1982). Many other domains such as listening comprehension, making inferences, oral expression (recreating sentences), semantic absurdities and definitions were also found to be significantly poor in persons with MS when compared to healthy controls (Barwood & Murdoch, 2013). The authors correlated the significant findings in spontaneous speech, naming and repetition to the deficits in sentence organization and lexical retrieval. The authors specifically attribute the difficulty in lexical- semantic processing difficulties in MS to the decline in cognitive functions such as memory. They also postulate that difficulty in naming to the deficits in lexical access, semantic organization and visual perception. Thus they conclude that the naming difficulties were due to the inability to retrieve words from mental lexicon and not due to breakdown in knowledge of the lexicon as seen in dementia.

A study by Perez (2016) included 100 persons with remitting-relapsing MS with average disease course of 8 years, who underwent an interview and four behavioral measures for the assessment of domains such as attention, semantics, picture naming and memory. The participants had accuracy scores and speed of processing lower for the tasks such as attention,

memory, verbal fluency, picture naming, visuo-spatial skills than the control group. The author also found that the presence of dysarthria increased the word retrieval difficulty in persons with MS, which they found using corelational analysis between severity of dysarthria and scores on naming abilities. The difficulties in lexical access in persons with MS were attributed to first stage of lexical-semantic processing, which is retrieval of features of the objects and not the retrieval of words itself.

In a recent review of studies on language in MS conducted from 1990 to 2015, Renauld, et al. (2016) found that language impairments occurred less frequently and that cognitive functions such as executive functions were the most commonly affected. Out of the language symptoms affected, word retrieval in verbal fluency was the most common deficit as it involved set switching and inhibition. As in the previous studies on lexical access, these authors also correlated language impairment with cognitive function such as memory and executive functions rather than the direct semantic organization of lexicon.

Ebrahimipour, et al. (2017) considered 90 persons with remitting relapsing MS and 90 healthy controls and investigated the lexical access abilities using Homophone meaning generation test (HMGT, Ebrahimipour, Weisi, Rezaei, Motamed, Ashayeri, Modarresi, & Kamali, 2008) and 60 seconds semantic and phonemic fluency tasks. The HMGT assesses the retrieval flexibility and verbal fluency tasks assess the lexical knowledge and access. The authors found that the persons with MS had lower scores in word generation, number of words in verbal fluency and switches but had adequate clustering. On correlation analysis, the authors found that there was a positive correlation between scores of HMGT and switching scores of verbal fluency tasks. The authors concluded that HMGT was more sensitive to identify the lexical access abilities in persons with MS, as it taps directly on word search strategies rather than word

fluency which involve both lexical knowledge and lexical search. They speculated that the poor performance in lexical access was mainly due to impaired cognitive abilities such as strategic search, response initiation, monitoring, shifting, and flexibility.

Thus to sum up, a look into the literature revealed that studies have been conducted to assess language impairments, such as lexical access abilities in persons with MS. These studies revealed that persons with MS performed poorer than healthy controls in language lexical access. From the literature review on lexical access abilities in persons with MS, it was also seen that they had more difficulty with lexical access (search strategies) than in lexical knowledge (lexical repertoire). Most of the studies in the past have also concluded that the lexical access problem was associated with impaired cognitive flexibility and retrieval of information, than an impairment in the lexical pool. These functions have been studied using tasks such as semantic/verbal fluency and they attributed the difficulty in these tasks to decline in cognitive flexibility with progress in disease. Such studies in MS are limited, as it is a highly variable neurodegenerative condition because of the varied disease course and the site of demyelination/inflammation. Hence the results of these studies cannot be generalized to all types of MS. Although in the recent past, studies in the west have been investigating such deficits in persons with MS, there are hardly any studies in India that focus on them. The tasks used to assess the lexical access in MS most commonly are confrontation naming and verbal fluency. Limited studies have focused on investigating lexical access through the use of more complex tasks such as coordinate, superordinate and generative naming. Most studies have also focused on cognitive domains such as attention and memory but rarely focused on subtle language abilities in MS. Thus this study was conducted in order to investigate more subtle language impairments such as lexical access in persons with remitting-relapsing MS considering factors

such as duration since onset and cognition. Studies in the past have shown that even persons with MS who had minimal or no cognitive impairment, exhibited difficulty in lexical access. This study which considered duration and cognition as variables would facilitate the early identification and diagnosis of language impairment in persons with MS and referral of such persons to speech-language pathologists when any word retrieval difficulties manifested.

CHAPTER III

Method

The present study attempted to study the lexical access abilities of Tamil speaking persons with remitting-relapsing MS. The main objective of the study was to compare the performance of persons with remitting-relapsing MS on lexical access tasks with a group of healthy controls. The second objective was to investigate the effects of duration of disease and cognitive abilities on the lexical access in persons with remitting-relapsing MS.

3.1 Participants

Ten persons (4 males and 6 females) with remitting-relapsing MS (diagnosed by a Neurologist) with native language as Tamil between the age range of 18-50 years (36.5 years; SD- 8.00) and with an average disease duration of 37.7 months (7-96 months) were considered for the study. This constituted the clinical group who were recruited from the Tamil Nadu Government Multi Super Specialty Hospital, Chennai. Ten age, gender and language matched neurotypical healthy individuals were considered in the control group.

The clinical and control group were also matched for socio-economic status using the NIMH socioeconomic status scale by Venkatesan (2011). The scale has sections such as occupation and education of the parents, annual family income and property to assess the socioeconomic status of the participants. Each of the section is scored on a 5 point rating scale, based on the level of occupation and education of the parents, annual family income and property. The scores of all the sections were summed up and matched with the SES status, a score of 0-4 indicated SES I; a score of 5-8 indicated SES II; a score of 9-12 indicated SES III; a

score of 13-16 indicated SES IV and a score of 17-20 indicated SES V. The participants selected for the study had belonged to SES IV and V status.

Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) was also administered for both groups. It is a 30 point questionnaire that is extensively used in clinical and research setting to measure cognitive impairment. It examines functions including registration, attention and calculation, recall, language, ability to follow simple commands and orientation. Any score greater than or equal to 24 points indicates normal cognition. Scores below this can indicate severe (≤9 points), moderate (10-18 points), or mild (19-23 points) cognitive impairment. Only two participants in the clinical group had mild cognitive impairment, while all the other participants had normal cognitive function.

The participants were native speakers of Tamil and knew English as well. International Second Language Proficiency Ratings (ISLPR, Ingram, 1985) was administered to analyze the language proficiency in their second language in order to control the cognitive advantage found in bilingual speakers. The ISLPR is an adaptive test procedure which can be used to assess the language proficiency of a person in any language. The scores range from zero proficiency to native-like proficiency, scored based on macro-skills of a language which includes writing, reading, speaking and listening. It describes language skills in terms abilities to use language for communication rather than comprehension and expressive abilities. The rating scale consists of 12 levels of proficiencies. Few examples to describe the scoring patterns include Minimum 'Creative' Proficiency which indicates a person who can satisfy his immediate needs using his/her second language; Transactional proficiency which represents a person who can satisfy his/her communication exchanges using his/her second language; Basic 'vocational' level represents a person with proficiency to use the language to satisfy his/her vocational needs. The

scores of ISLPR for the participants in both the groups ranged between Minimum Creative proficiency and Basic Vocational proficiency. The details of the clinical and control group have been depicted in Table 3.1 and 3.2.

Table 3.1

Demographic details of the clinical group

#P	**Age (in Years)**	**Gender**	**#SES**	**#MMSE**	**#ISLPR**	**Duration of disease (months)**
P 1	42	F	4	20	Minimum creative proficiency	48
P 2	43	F	4	30	Basic vocational proficiency	12
P 3	34	F	5	30	Basic vocational proficiency	24
P 4	47	M	4	25	Basic transactional proficiency	36
P 5	29	M	4	29	Minimum creative proficiency	24
P 6	37	M	4	30	Social proficiency	10
P 7	35	F	3	21	Minimum creative proficiency	24
P 8	23	F	5	27	Social proficiency	7
P 9	46	F	4	27	Basic transactional proficiency	96
P 10	29	M	4	30	Basic transactional proficiency	96

 # Participant (P), Socioeconomic status (SES), Mini Mental State Examination (MMSE) and International Second Language Proficiency Rating (ISLPR)

Table 3.2

Demographic details of the clinical group

#P	Age (in Years)	Gender	#SES	#MMSE	#ISLPR
P 1	42	F	4	30	Minimum creative proficiency
P 2	43	F	4	30	Basic vocational proficiency
P 3	34	F	5	30	Basic vocational proficiency
P 4	47	M	4	30	Basic transactional proficiency
P 5	29	M	4	30	Minimum creative proficiency
P 6	37	M	4	30	Social proficiency
P 7	35	F	3	30	Minimum creative proficiency
P 8	23	F	5	30	Social proficiency
P 9	46	F	4	30	Basic transactional proficiency
P 10	29	M	4	30	Basic transactional proficiency

 # Participant (P), Socioeconomic status (SES), Mini Mental State Examination (MMSE) and International Second Language Proficiency Rating (ISLPR)

Inclusion criteria

Only the participants diagnosed as clinically definite remitting-relapsing MS by an experienced Neurologist were included in the clinical group. The participants within 3 months of the last relapse of the condition were selected. Only those participants without any visual and auditory defects (corrected if present) were selected. They had to obtain a score of three or less on the AYJNIHH Speech Intelligibility Rating Scale (2008). This criterion was considered as Perez (2016) found that intelligibility had a direct effect on the performance in lexical access in persons with MS.

Stimuli

Lexical access abilities were assessed using Confrontation Naming subtest from Cognitive-Linguistic Quick Test- Kannada (CLQT-K) developed by Vandana and Shyamala (2011) and Semantic Memory subtest of Cognitive Linguistic Assessment Protocol – Kannada (CLAP-K) developed by Kamath and Prema (2003). The confrontation naming task of CLQT-K consisted of ten pictures where the participants were asked to name pictures of items shown (e.g., Hen, Tie, etc). The sections on coordinate naming, Superordinate naming, Word naming fluency and Generative naming were selected from the semantic memory subtest of CLAP-K.

Procedure

The method involved four phases**.**

PHASE I: This involved the translation of the stimuli by three speech-language pathologists who were native speakers of Kannada and proficient in Tamil.

PHASE II: This involved validation of the translated stimuli by three experienced Speech-language pathologists who were native speakers of Tamil and proficient in Kannada. All the

validated items had an inter-judge agreement above 80%. Based on the feedback provided by them, few stimuli words were changed (tʃappal was changed to seruppu; mani was changed to neram). In addition, one stimulus in superordinate was deleted as it did not have translation equivalent in Tamil (athuva).

PHASE III: A pilot study was conducted on 5 persons with MS using the validated stimuli, which were verbally presented to the participants. Based on the pilot study, presentation time for the stimuli and time constraints to respond were made constant across the participants in order to make the stimulus presentation consistent. Thus, the stimuli were recorded using PRAAT (Boersma & Weenink, 2018) software by an adult male native Tamil speaker and then saved as .wav files. They were then fed to a power point presentation and the response slide which followed the stimuli slide was timed for 30 seconds, which indicated that a participant had 30 seconds to respond to the stimuli presented. Also based on the literature review and pilot study, the response criteria for co-ordinate and word fluency were changed where the participants were to give as many as names within thirty seconds of time. Two vowels (/a/ and /i/) were also deleted from word naming fluency in accordance with literature.

PHASE IV: This involved administration of the tasks on persons with MS and the healthy controls. A rapport was built with the client by engaging in a casual conversation. The demographic data and a detailed medical history were obtained. Following this, the preliminary assessments and screening procedures were carried out. NIMH socioeconomic status scale, ISLPR and MMSE were then administered on both the clinical and the control group. A spontaneous speech sample was obtained which was then scored perceptually for intelligibility using 7 point AYJNIHH Speech Intelligibility Rating Scale. This was followed by the

assessment of lexical access by administering the translated and validated stimuli from CLQT-K and CLAP-K. The details of the tasks used have been provided below:

1. Confrontation Naming: The participants were asked to name pictures of ten common objects.

2. Coordinate naming: This task contained only one stimulus**.** The participants were asked to produce as many names as possible belonging to the given noun-class by the examiner (e.g., Give as many objects as possible which are used to write)

3. **Super-ordinate naming:** This task was complementary to co-ordinate naming and included five stimuli. A list of items belonging to a particular class was given to the participants. The task was to identify the class to which the given items may be classified (e.g., What class does "cat, elephant, tiger, monkey" belong to?)

4. Word naming fluency: This task contained three stimuli. The participants were asked to name as many words as possible that began with a particular phoneme (e.g., Name as amny words as possible that begin with "p"). The vowel stimuli were deleted as cluster and switching cannot be quantified for them.

5. Generative naming: This task contained three stimuli. The participants were asked to name the target word, the descriptions for which were given (e.g., What do we use to eat?)

The participants were seated in a comfortable position. The testing was carried out in a room with less ambient noise and visual distractions. The stimuli were presented through headphones binaurally at comfortable loudness. The time taken to complete the full profiling and data collection was around 20-30 minutes for each participant. The responses of all the

participants were audio recorded which were subjected to further analysis. All ethical procedures were followed. A written consent was obtained from all the participants before the data collection.

Scoring and Analysis

The responses were scored as per the scoring protocol provided in CLQT-K and CLAP-K. A score of 1 was provided for each correct response and score of 0 was provided for incorrect responses. The audio recorded samples of both clinical and control group for confrontation naming was subjected to naming error analysis, and samples of coordinate naming and word naming fluency tasks were subjected to analysis of switching and clustering strategies. The naming errors were classified as semantic errors (if response was semantically related to target, for example, if the person produces car for train), perceptual errors (if response was visually similar to target, for example if the person produces coil for snail) and no relationship errors (if response was unrelated to the target, for example bag for banana). The cluster sizes and number of switches were calculated. Switching and clustering are frequently used mechanisms to assess the lexical access abilities (Troyer, 2000). Cluster is a group of words which are produced successively within the same category (co-ordinate naming) or with same first two phonemes (word naming fluency). For calculating the clusters in co-ordinate naming, the responses produced were categorized into items which were used to write and items which augmented the writing. Thus in co-ordinate naming, if two words were successively produced within a category (used to write/augment writing), then it was considered a cluster. In word naming fluency, if two words were successively produced with the same first two phonemes it was considered a cluster. The average of the number of items in each cluster was calculated in order to obtain the cluster

size. Switches were considered when there was a change from a cluster to a next word which belongs to another cluster.

Table 3.3

An illustration for calculating cluster size and switches in co-ordinate naming and word naming fluency tasks

Tasks	Response	Cluster Size	Switches
Co-ordinate Naming	pen, pencil, marker, paper, pad, board and chalk	3	3
Word Naming fluency	parrot, parcel, packet, picnic, pick, pigeon and pole	3	3

In the above mentioned example, in co-ordinate naming, ‘pen’, ‘pencil’ and ‘marker’ are considered as a cluster, as they are used to write and when the person switches to ‘paper’, ‘pad’ and ‘board’ which augments writing, it was considered another cluster and ‘chalk’ is not considered as a cluster as it is a single word. Thus, cluster size is 3 as the number of items in the two clusters is 3 and the average of it is taken. The number of switches is calculated as three because the person switches from one cluster to another cluster (things used to write to things that augment writing) and again from the second cluster to the word ‘chalk’ which is used to write. Similarly for word naming fluency, ‘parrot’, ‘parcel’, ‘packet’ are considered one cluster as they have same first two phonemes, and when the person switches to ‘picnic’, ‘pick’, ‘pigeon’ which have different second phoneme, it is considered another cluster. Thus, cluster size is 3 as the number of items in the two clusters is 3 and the average of it is taken. The number of switches is three because the person switches from one cluster to another cluster and again from

the second cluster to next word (‘pole’) which begins with /po/ and does not belong to the previous cluster.

Reliability

Inter-rater reliability: Apart from the investigator, all the samples were further analyzed by two other judges. The judges were experienced speech-language pathologists who had a minimum of two years experience in the assessment and intervention of adult language disorders. The judges were familiarized on the operational definitions on various lexical access skills assessed. The scoring of subtest was also described. After familiarizing, the judges were blinded to the purpose study. Identity of the participants was not revealed. The recordings were shown to the judges. The judges were given the freedom to play the samples as many times as they wanted. The judges were asked to score 0 and 1 for wrong and correct responses repeatedly and to calculate the naming errors and the cluster size, and switches. There was no time constraints applied to the judges for the analysis. The scores obtained from all the three judges (including the investigator) was calculated and assessed for reliability.

Test-retest reliability was established for 10% of the participants selected for the study from each group. They were tested within a span of one to two weeks.

Statistical analysis

After analysis of the accuracy for each task, the data was tabulated, averaged across participants in both groups and subjected to statistical analysis in Statistical Package for the Social Sciences (SPSS) software package (Version 20.0). Descriptive statistics was used to calculate mean, median and standard deviation for both the groups. The scores of both the groups were compared using Mann-Whitney U test. The influence of disease duration and cognition

were assessed using a Spearman's rank correlation. Cronbach's alpha was used to assess test-retest and inter-rater reliability. The results are presented and discussed in the next chapter.

SSCHAPTER IV

Results and Discussion

` The present study aimed to investigate the lexical access abilities of Tamil speaking persons with multiple sclerosis (clinical group), by comparing them with a matched group of neurotypical individuals (control group) and to correlate their lexical access abilities with the duration of the disease and cognitive abilities. A total of ten participants were included in the clinical and control group respectively. The confrontation naming subtest of CLQT-K and semantic memory subtest of CLAP-K which included Co-ordinate naming, superordinate naming, Word naming fluency, and Generative naming tasks were translated, validated, and administered on both the groups. The responses were scored as per the scoring instructions provided in the respective manuals. In addition, cluster size and switches in coordinate naming and word naming fluency, referred to lexical access strategies, were calculated. Test-retest reliability and inter-rater reliability was calculated for all the tasks. The data obtained from both the groups was tabulated and analyzed using SPSS software version 20. The following statistical procedures were used:

- Cronbach's alpha test was obtained for determining the test-retest reliability.
- Descriptive statistics was carried out for lexical access tasks and lexical access strategies.
- Mann-Whitney U test was employed to find out the significant difference, if any, between the groups for performance in lexical access tasks and the lexical access strategies.
- Pearson's correlation was employed to assess the relationship between the scores obtained on various lexical access tasks and duration of disease. Further the relationship between cognitive performance and scores on various lexical access tasks was also

assessed using Pearson's correlation. Both these were performed only within the clinical group.

The results obtained for each group for each task has been presented and discussed in this chapter under different sections:

4.1 Reliability

4.2 Comparison of both the groups on various tasks of lexical access

4.3 Comparison of both the groups on strategies of lexical access

4.4 Relationship between cognitive abilities and performance on various lexical access tasks in clinical group

4.5 Relationship between duration of disease and performance on various lexical access tasks in clinical group

4.1 Reliability

Test-retest reliability

Testing was repeated for 10% of the samples from both the control and clinical group. There was 100% test-retest reliability for confrontation naming, generative naming and switching of co-ordinate naming for both groups. The test-retest reliability was calculated for other tasks using the Cronbach's alpha test, which was found be >0.90 for both the groups. This suggested adequate levels of test-retest reliability for the control and clinical group for all the lexical access tasks and strategies. The test-retest reliability for lexical access tasks and strategies for both the groups has been presented in Table 4.1.

Table 4.1

Test-retest reliability scores for both the groups for lexical access tasks and strategies

Tasks#	Clinical group	Control group
CON	0.96	0.87
SN	0.96	0.75
WNF	0.91	0.95
SC	0.99	0.99
CWNF	0.84	0.95
SWNF	0.99	0.99
SWWNF	0.98	0.94

 # Co-ordinate Naming (CON), Super-ordinate Naming (SN), Word naming fluency (VF) Cluster Size of Co-ordinate naming (SC),Cluster Size of Word naming fluency (SWNF) and Switches of word naming fluency (SWWNF).

Inter-rater reliability

The samples collected from both control and clinical groups were re-examined by two other judges apart from the investigator. The inter-rater reliability was 100% for all tasks of lexical access and strategies of lexical access except for switches in word naming fluency. The inter-rater reliability was thus calculated for switches in word naming fluency using Cronbach's alpha test, which was found to be greater than 0.99 for the clinical group and 0.96 for the control group, which indicated high inter-rater reliability.

4.2 Comparison of both the groups on various tasks of lexical access

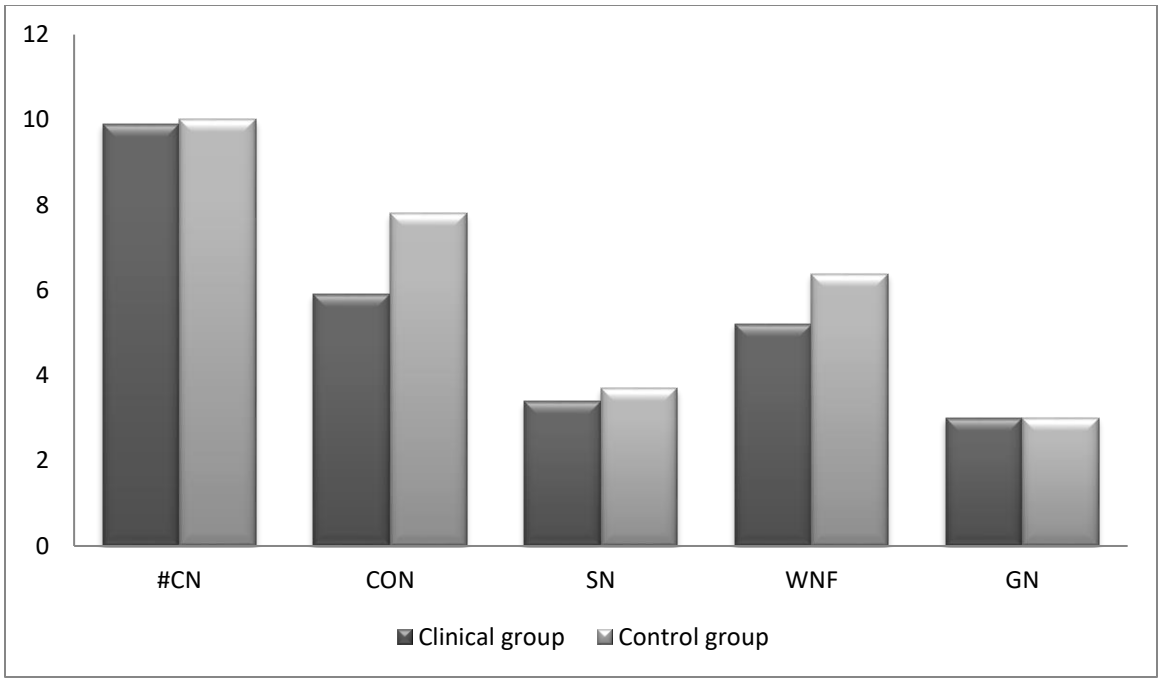
The performance of both the groups on each lexical access task was analyzed. The tasks included confrontation naming (CN), co-ordinate naming (CON), super-ordinate naming (SN), word naming fluency (WNF) and generative naming (GN). The data was subjected to descriptive statistical methods to obtain the mean, median and the standard deviation. Table 4.2 depicts the mean and standard Deviation (SD) values of different tasks. Figure 4.2 depicts the performance of both the groups on the various tasks of lexical access.

Table 4.2

Mean, standard deviation (SD) and /z/ values of both clinical and control group on tasks of lexical access

Tasks #	**Clinical Group**		**Control group**		**/z/ values**
	Mean	**SD**	**Mean**	**SD**	
CN	9.9	0.31	10.0	0.00	1.00
CON	5.90	2.60	7.80	2.74	1.60
SN	3.40	1.64	3.70	0.48	0.04
WNF	5.21	1.51	6.38	2.21	1.71
GN	3.00	0.00	3.00	0.00	0.00

 # Confrontation Naming (CN), Co-ordinate Naming (CON), Super-ordinate Naming (SN), Word naming fluency (WNF) and Generative Naming (GN)



 # Confrontation Naming (CN), Co-ordinate Naming (CON), Super-ordinate Naming (SN), Word naming fluency (WNF) and Generative Naming (GN)

Figure 4.1 Performance of clinical and control group on various tasks of lexical access.

Confrontation Naming

The task of confrontation naming involved the participants to say the names of the pictures presented which is a language task by itself. On comparison of the mean scores between the two groups on the confrontation naming task, it was seen that the clinical group obtained a lesser mean score than the control group. This indicated that the clinical group performed poorer on the task than the control group, however there was only a very minimal difference in score between the groups. The mean values were subjected to Mann-Whitney U test to determine significant difference, if any, between the two groups. The results revealed no statistical significance between the clinical and control group on the task of confrontation naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.2.

Co-ordinate naming

In this task the participants had to give as many names as possible belonging to the given noun-class in 30 seconds of time. This task involved both language and cognitive skills such as executive functions. The clinical group obtained a mean of 5.9 (SD= 2.60) and the control group obtained mean of 7.8 (SD= 2.74) in the task of co-ordinate naming. These mean scores indicated that the clinical group performed poorer than the control group. The mean values were subjected to Mann-Whitney U test to determine, significant difference, if any, between the two groups. The results of Mann-Whitney showed no statistical significance between the two groups on the task of co-ordinate naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.2.

Superordinate naming

In this task the participants had to name the class to which the given item belonged to. The clinical group obtained a mean of 3.4 (SD= 1.64) and the control group obtained mean of 3.7 (SD= 0.48) in the task of super-ordinate naming (Table 4.2.1). These mean scores indicated that the clinical group performed almost similar to the control group. The results of Mann-Whitney showed no statistical significance between the clinical and control group on the task of super-ordinate naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.2.

Word naming fluency

In this task the participants had to provide as many names as possible starting with a given phoneme given in 30 seconds of time. This task involved both language and cognitive skills such as attention and executive functions. The clinical group obtained a mean of 5.2 (SD= 1.51) and the control group obtained mean of 6.3 (SD= 2.21) in the task of word naming fluency.

These mean scores indicated that the clinical group performed poorer than the control group. The mean values were subjected to Mann-Whitney U test to determine, significant difference, if any, between the two groups. The results of Mann-Whitney showed no statistical significance between the clinical and control group on the task of word naming fluency. The mean, standard deviation and the /z/ values have been depicted in Table 4.2.

Generative naming

In this task the participant had to say the name of an item for which the description was provided. The clinical group obtained a mean of 3 (SD= 0.00) and the control group obtained mean of 3 (SD= 0.00) in the task of word naming fluency. These mean scores indicated that the clinical group performed on par with the control group. The mean values were subjected to Mann-Whitney U test to determine, significant difference, if any, between the two groups. The results of Mann-Whitney showed no statistical significance between the clinical and control group on the task of generative naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.2.

The findings indicated that there was no statistically significant difference between the two groups on all the naming tasks. These findings are in agreement with a few studies in the past who found no significant impairment in lexical access (Olivares, et al., 2005; Bensa, et al., 2006). However, a few other studies in the past have found a significant lexical access difficulty in persons with MS, which was attributed to the cognitive dysfunction such as poor processing speed and executive functions (Beatty & Monson, 1990; Lethlban & Murdoch, 1994; Ebrahimipour, et al., 2008; Tallberg & Bergendal, 2009; Sepulcre et al., 2010; Barwood & Murdoch, 2014; Perez, 2016; Renauld et al., 2016; Ebrahimipour et al., 2017). In the present

study, only two persons with MS had mild cognitive impairment, based on MMSE scores. This could have led to the differences in the findings.

Further, the differences in findings could also be attributed to the differences in the duration of disease for the persons with MS. The duration of MS included in the present study was 37.7 months, which was lesser than the duration of disease of the population considered by the authors in the past. Studies in the past considered participants with average disease duration of 16years (Lethlean & Murdoch, 1994); 20 years (Tallberg & Bergendal, 2009); 6 years (Sepulcre et al., 2010); 15 years (Barwood & Murdoch, 2014); and 8 years (Perez, 2016) which is comparably more than the duration of disease considered in the present study (3 years).

The type of MS considered in different studies could also have influenced the findings. The participants considered in the present study were specifically the remitting-relapsing type of MS and were in the remitting phase. However some studies have included all types of MS including clinically isolated syndrome, remitting-relapsing, secondary progressive and primary progressive (Beatty & Monson, 1990; Lethlean & Murdoch, 1994; Sepulcre et al., 2010).Bensa et al. (2006) also found that the cognitive impairment improved after two years of initial assessment in persons with remitting-relapsing MS. According to them, remitting-relapsing MS is characterized by heterogeneity and also fluctuations in functions.

Further the differences in findings could be attributed to the difference in the languages and the number of languages known to the participants considered. Studies in the past reported that performance in lexical access varied across language (Rosselli et al., 2002). The present study considered Tamil speaking participants, whereas the studies in the past have considered language such as English (Beatty & Monson, 1990; Lethlean & Murdoch, 1994; Sepulcre et al.,

2010; Barwood &Murdoch, 2014; Perez, 2016), Farsi (Ebrahimipour et al, 2008), Spanish (Tallberg & Bergendal, 2009) and Persian (Ebrahimipour et al., 2017). Also most of the studies in the past (Beatty & Monson, 1990; Lethlean & Murdoch, 1994; Ebrahimipour et al., 2008; Tallberg & Bergendal, 2009; Sepulcre et al., 2010; Barwood & Murdoch, 2014; Perez, 2016) considered monolingual participants speaking one language, but the present study considered participants who had bilingual language proficiency (three participants had minimum creative proficiency, three participants had basic transactional proficiency, two participants had social proficiency, two participants had basic vocational proficiency). This could have influenced the decline in cognitive abilities (Bialystok, 2011; Calvo, García, Manoiloff, & Ibáñez, 2015; Vélez & Tranel, 2015).

It was seen that the persons with MS performed poorer in some of the tasks such as co-ordinate naming, super-ordinate and word naming fluency, however the performance by both the groups in tasks such as confrontation naming and generative naming were comparable. This could be because of the fact that tasks such as co-ordinate naming and word naming fluency depends on lexical access abilities and confrontation naming and generative naming depends on the lexical knowledge (Sepulcre et al, 2010). A few studies have found that in persons with MS, lexical access was more affected than the lexical knowledge (Beatty & Monson, 1990; Tallberg & Bergendal, 2009; Barwood & Murdoch, 2014; Ebrahimipour et al., 2017).

Additionally, the type of errors made by the participants in confrontational naming task was analyzed. There were only two participants in the clinical group who made naming errors and both of them were semantic errors. This is in agreement with the study by Lethlean and Murdoch (1994), who investigated the lexical access abilities in persons with MS using BNT and analyzed the naming errors. They found that semantic errors were more, which signified a

semantic access deficit. The authors attributed these errors to demyelination in cortical-subcortical pathways which are important for attention and monitoring.

It was also observed that during the data collection process, the clinical group required the stimuli for co-ordinate naming and word naming fluency tasks to be presented more number of times than the control group as they had difficulty in understanding the auditory stimuli. Valadbeigi et al. (2014) also reported that though the persons with MS had a normal peripheral hearing determined through pure tone audiometry, they would have central processing difficulties.

4.3 Comparison of both the groups on strategies of lexical access

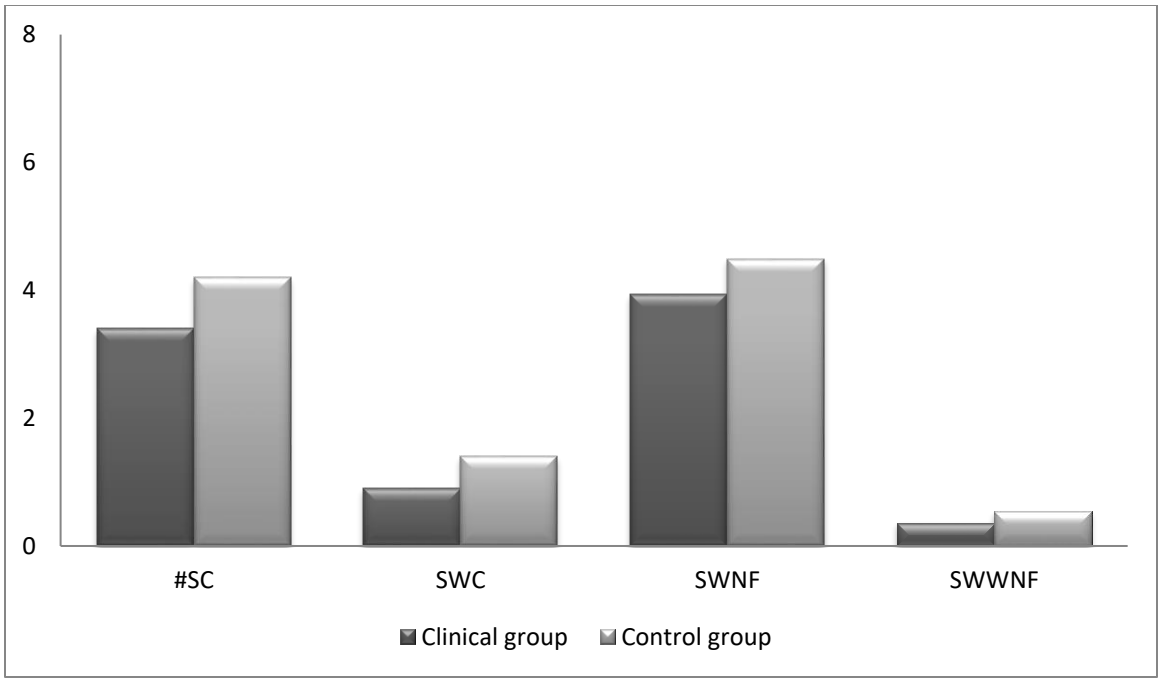
The strategies of lexical access used by both the groups were analyzed for co-ordinate naming (CON) and word naming fluency (WNF). The data was subjected to descriptive statistical methods to obtain the mean, median and the standard deviation. Table 4.3 depicts the mean and standard Deviation (SD) values of different strategies of lexical access. Figure 4.2 depicts the performance of both the groups on the various strategies of lexical access.

Table 4.3

Mean, standard deviation (SD) and /Z/ values of both clinical and control group on various strategies of lexical access

#Task	Clinical group		Control group		/Z/ Value
	Mean	**SD**	**Mean**	**SD**	
SC	3.40	1.14	4.20	1.31	1.47
SWC	0.90	0.73	1.40	0.51	1.60
SWNF	3.93	1.56	4.49	2.19	0.83
SWWNF	0.36	0.60	0.54	0.49	0.90

Cluster Size of co-ordinate naming (SC) and Switches of coordinate naming (SWC) and Cluster Size of word naming fluency (SWNF), Switches of word naming fluency (SWWNF).



Cluster Size of Co-ordinate naming (SC), Switches of coordinate naming (SWC) and Cluster Size of Word naming fluency (SWNF), Switches of word naming fluency (SWWNF).

Figure 4.2 Performance of clinical and control group on strategies of lexical access.

A cluster was considered when two successive words in the response belonged to the same category in co-ordinate naming. The average of the number of items in each cluster was calculated in order to obtain the cluster size for co-ordinate naming. The clinical group obtained a mean of 3.40 (SD= 1.14) and the control group obtained mean of 4.20 (SD= 1.31) in the cluster size for co-ordinate naming. These mean scores indicated that the clinical group performed poorer than the control group. The results of Mann-Whitney showed no statistical significance [/Z/= 1.47, p> 0.05] between the clinical and control group on cluster size for co-ordinate naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.3.

Switches were considered as the change between a cluster and the next single word. The clinical group obtained a mean of 0.90 (SD= 0.73) and the control group obtained mean of 1.40 (SD= 0.51) in the number of switches for co-ordinate naming. These mean scores indicated that

the clinical group performed poorer than the control group. The results of Mann-Whitney showed no statistical significance [Z= 1.60, p> 0.05] between the clinical and control group on number of switches for co-ordinate naming. The mean, standard deviation and the /z/ values have been depicted in Table 4.3.

There was no significant difference between the groups on both these lexical strategies. The cluster size was smaller in persons with MS than in the control group, which is concurrence with the results obtained by Tallberg & Bergendal (2009) where there was no significant difference between clinical and control group in the cluster size with the scores lesser in the clinical group. But the findings of the present study is not in agreement with the findings of Sepulcre et al (2010) who found that cluster size was more in persons with MS as they have to compensate for the reduction in switching abilities. The switching strategy depends more on lexical access abilities (Tallberg & Bergendal, 2009; Sepulcre et al., 2010) than the lexical knowledge. The poorer mean scores w.r.t. switching indicated that persons with MS had greater difficulty in lexical search than in lexical knowledge. This is also supported by the finding that persons with MS performed similar to the healthy individuals in tasks such as confrontation naming and generative naming that depend more on lexical knowledge than search.

With respect to word naming fluency, cluster was considered when successive two words in the response were produced with the same first two phonemes. Cluster size was also calculated for word naming fluency by averaging the number of items in each of the cluster. The clinical group obtained a mean of 3.93 (SD= 1.56) and the control group obtained mean of 4.20 (SD= 1.31) in cluster size for word naming fluency which indicated that the clinical group performed poorer than the control group. The results of Mann-Whitney showed no statistical significance [Z= 0.83, p> 0.05] between the clinical and control group on number of clusters for

word naming fluency. The mean, standard deviation and the /z/ values have been depicted in Table 4.3.

Number of switches was also calculated for word naming fluency by taking the average of switches. The clinical group obtained a mean of 0.36 (SD= 0.60) and the control group obtained mean of 0.54 (SD= 0.49) in number of switches. These mean scores indicated that the clinical group performed poorer than the control group. The mean values were subjected to Mann-Whitney U test to determine, significant difference, if any, between the two groups. The results of Mann-Whitney showed no statistical significance [Z= 0.49, p> 0.05] between the clinical and control group on number of switches for word naming fluency. The mean, standard deviation and the /z/ values have been depicted in Table 4.3.

There was no significant difference found between the clinical and control group in switching and cluster size in both co-ordinate naming and word naming fluency. But the participants in the clinical group obtained poorer mean scores in both these strategies. These findings are not in agreement with the study by Sepulcre et al, (2010) who found that persons with MS performed significantly poorer than the control group using verbal fluency and semantic fluency tasks. They also found that the number of clusters was more in the clinical group than the control group and switches were more and they attributed this increase in cluster to the compensatory strategy. Ebrahimipour et al. (2017) also got similar results where persons with MS had significant difference in verbal and semantic fluency performance and switching strategy in both verbal and semantic fluency. They also found the clinical group had significantly better scores in clustering for verbal and semantic fluency. It can be conclude that persons with MS have poor lexical access as they performed poorer than the control group on lexical access strategies such as switching.

4.4 Relationship between cognitive abilities and performance on various lexical access tasks in the clinical group

A Spearman's rank correlation was run to determine the relationship between the tasks of lexical access and cognitive abilities of the participants in clinical group. There was no correlation between any of the lexical access task and MMSE scores in the clinical group. These results are in agreement with study by Bensa et al. (2006). They found no significant differences between persons with remitting-relapsing MS and healthy controls in tasks of lexical access. They also found that the cognitive abilities improved with duration and cognitive impairment in persons with MS was not correlated with lexical access abilities.

However studies in persons with MS found a correlation between cognitive and lexical access abilities (Beatty & Monson, 1990; Tallberg & Bergendal, 2009). Olivares et al. (2005) also assessed lexical access in persons with MS and used MMSE to evaluate the cognitive abilities. They found no significant difference between the clinical and control group on lexical access tasks and also found no correlation between the lexical access abilities and cognitive abilities.

The reduced correlation between cognitive functions and lexical access abilities can also be due to insensitivity of the cognitive test (MMSE) in detecting the cognitive impairment. Beatty and Monson (1990) had used SECIMS due to the insensitivity of MMSE. Trenova et al. (2016) also postulated that tests such as Minimal Assessment of Cognitive Function in Multiple Sclerosis (MACFIMS, Benedict, Fischer, Archibald, Arnett, Beatty, Bobholz, & Foley, 2002); Brief Repeatable Battery of Neuropsychological Test (BRBNT, Rao, 1990); Repeatable Battery for Assessment of Neuropsychological Status (RBANS, Randolph, 1998); Screening Examination for Cognitive Impairment (SEFCI, Beatty, Paul, Wilbanks, Hames, Blanco, &

Goodkin, 1995); and Brief International Cognitive Assessment for MS (BICAMS, Benedict, Amato, Boringa, Brochet, Foley, Fredrikson, & Reder, 2012) are more sensitive to identify cognitive deficits in persons with MS. Hence there is a need to develop and or adapt similar tests in the Indian context.

Other factors such as duration of the disease and number of languages known could also have influenced the findings of the study. Most of the studies in the past (Beatty & Monson, 1990; Lethlean & Murdoch, 1994; Ebrahimipour et al., 2008; Tallberg & Bergendal, 2009; Sepulcre et al., 2010; Barwood & Murdoch, 2014; Perez, 2016) had considered monolingual participants, but the present study included participants who had bilingual language proficiency. Studies in past have documented the advantage that bilingual individuals have in cognitive abilities (Bialystok, 2011; Calvo, García, Manoiloff, & Ibáñez, 2015; Vélez & Tranel, 2015). There have been studies that report the onset of dementia symptoms are delayed in bilingual individuals (Bialystok, 2011). The authors postulate that this is probably due to the mechanism of cognitive reserve (ability of the brain to compensate for the functional loss following any damage from disease or with biological aging) in bilingual individuals.

4.5 Relationship between duration of disease and performance on various lexical access tasks in the clinical group

A Spearman's rank correlation was run to determine the relationship between the tasks of lexical access and duration of the disease. There was no correlation found between any of the tasks of lexical access and duration of the disease. However, there was a strong positive correlation between the disease duration and cluster size of co-ordinate naming ($\rho = 0.70$, $p < 0.05$) and a strong negative co-relation between the disease duration and switching in word naming fluency ($\rho = -0.67$, $p < 0.05$).

The results thus show that the cluster size of co-ordinate naming increases and switching strategy in word naming fluency decreases with increase in duration of disease. This is in consensus with the longitudinal study by Sepulcre et al. (2010). They studied semantic fluency and word naming fluency in persons with MS and found that with increasing duration, the cluster size of semantic fluency task increased. The increase in cluster size signified the compensatory mechanism developed in order to overcome the reduction in the switching strategy. They also found that with increasing duration of the disease, the switching strategy in semantic fluency decreased.

However, the present study found a decrease in switches in word naming fluency rather than in semantic fluency (co-ordinate naming) as in the study by Sepulcre et al. (2010). This could be attributed to the language related differences. The studies in the literature have been conducted in languages such as English (Beatty & Monson, 1990; Lethlean & Murdoch, 1994; Sepulcre et al., 2010; Barwood & Murdoch, 2014; Perez, 2016) Farsi (Ebrahimipour et al., 2008); Spanish (Tallberg & Bergendal, 2009); Persian (Ebrahimipour et al., 2017), while the present study was conducted in Tamil-speaking persons with MS. The findings in lexical access tasks could be different in different languages, which is in accordance with the findings of Rosselli et al. (2002) who studied verbal fluency abilities in two different languages and found that there was difference in performance of speakers of two different languages.

In the present study, there was no correlation between the duration of the disease and the performance on the naming tasks in persons with MS. In contrast, most studies in the past reported a strong correlation between the duration of the disease and decrease in the performance on lexical access tasks. This could be due the disease type considered in different studies. The studies in the past considered all the types of MS for studying the lexical access (Beatty &

Monson, 1990; Lethlban & Murdoch, 1994; Tallberg & Bergendal, 2009; Sepulcre et al., 2010), whereas the present study considered only the remitting-relapsing MS. Remitting-relapsing MS has been considered a subtype characterized by heterogeneity and also fluctuations in functions (Bensa et al., 2006).

A correlation analysis was carried out using Spearman's rank correlation between the number of remissions, the persons with MS had and the lexical access scores of the persons with MS. The results revealed that there was no correlation between the two.

Thus to summarize, there was no significant difference between the persons with MS and the control group in lexical access tasks such as confrontation naming, co-ordinate naming, super-ordinate naming, word naming fluency and generative naming. However their mean scores were poorer in certain tasks such as co-ordinate naming, super-ordinate naming and word naming fluency. Thus more complex tasks such as co-ordinate naming and word naming fluency are essential to identify subtle deficits in persons with MS. Further, the cognitive abilities and duration of the disease did not correlate with the performance on the lexical access tasks. There was correlation found between the lexical access strategies and cognitive abilities, however the switching abilities decreased and the cluster size increased with disease progression. Thus the switching strategies in naming tasks such as word naming fluency decreased with increasing duration of disease irrespective of presence of evident cognitive impairment and such sensitive tasks can be considered in persons with MS.

CHAPTER V

Summary and Conclusions

Multiple Sclerosis (MS) is a progressive, degenerative, neurological disease associated with demyelination of the neurons especially the white matter of the brain. MS is usually classified into four types, namely, (a) clinically isolated syndrome, (b) remitting-relapsing, (c) secondary progressive and (d) primary progressive. It is usually manifested with a wide range of motor, sensory and cognitive symptoms. The symptoms vary depending the extent and location of the demyelination and usually include visual impairment, motor weakness, intentional tremor, in-coordination and cognitive symptoms such as memory deficits, executive function deficits and attention deficits.

The cognitive symptoms in persons with MS may lead to language deficits that can be highly disabling for the persons with MS. The presence of language impairment in persons with MS had been studied by several researchers, only in the last few years. Such studies revealed that linguistic functions such as repetition, vocabulary, word definitions, ambiguities, recreating sentences have been affected in persons with MS. The most common language function associated with MS studied in the literature is lexical access abilities using tasks such as verbal fluency and semantic fluency. Studies investigating lexical access abilities in persons with MS have found that the persons with MS have more difficulty in lexical access abilities than in lexical knowledge. This was concluded as the persons with MS had better scores in clustering than in switching strategies which are involved in semantic and verbal fluency. The studies have also found that such skills deteriorate with an increase in duration of the disease.

MS is associated with wide spread location of lesions, varying disease types and wide variations found even within the disease types. This variable nature of the disease manifestation makes it really difficult for the researchers to understand the deficits underlying the disease and to conclude on it. In India, there is a paucity of data on lexical access deficits in persons with MS and results obtained from western studies cannot be generalized to Indian population as there can be differences in the performance across language, ethnicity and culture. There are also very few studies which correlate the lexical access abilities with the duration of the disease. Hence there is a need to study the lexical access abilities in persons with MS especially in the Indian context. Keeping this in view, this study was planned.

The present study aimed to investigate the lexical access abilities in Tamil speaking persons with remitting-relapsing MS using a range of naming tasks. The specific objectives were to compare the lexical access abilities in persons with remitting-relapsing MS with healthy controls and also to correlate lexical access abilities in the persons with MS with the duration of disease and cognitive abilities.

The clinical group consisted of ten persons with remitting-relapsing MS with native language as Tamil in the age range of 18-50 years and with average disease duration of 37.7 months. The clinical group was recruited based on specific inclusion criteria. Ten age, gender and language matched neurotypical individuals constituted the control group. The clinical and control group were also matched using second language proficiency and socio-economic status. All the participants in the study belonged SES IV and SES V; also all had Minimum Creative proficiency and Basic Vocational proficiency in the second language.

The stimuli were adapted, translated and adapted from Cognitive-Linguistic Quick Test-Kannada (CLQT-K) developed by Vandana and Shyamala (2011) and Cognitive Linguistic Assessment Protocol – Kannada (CLAP-K) developed by Kamath and Prema (2003). The Confrontation Naming subtest from CLQT-K and Semantic Memory subtest of CLAP-K were included in order to assess the lexical access abilities. The confrontation naming task of CLQT-K consisted of ten pictures where the participants were asked to name pictures of items shown (e.g., Hen, Tie, etc). The tasks such as co-ordinate naming, superordinate naming, Word naming fluency and Generative naming were selected from the semantic memory subtest of CLAP-K. Co-ordinate naming involved the participants giving names belonging to a given noun class, super-ordinate naming involved the participants giving the name of the class to which the items presented belonged to, word naming fluency involved the participant giving words which begin with the given phoneme and generative naming involved the participants giving a target name for the description provided. The clinical group underwent Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) after which the tasks of CLQT-K and CLAP-K were administered. The tasks of CLQT-K and CLAP-K were administered to the control group too. In addition to scoring the data according to the manual, lexical access strategies such as clustering and switching were also calculated for co-ordinate naming and word naming fluency as it was found that individuals, group words into clusters in these two tasks (Troyer, 2000). Inter-rater and test retest reliability was established for both the groups. The data after analysis were subjected to statistical analysis using SPSS 20. The mean, median and standard deviations were computed. The mean values were subjected to different statistical procedures such as Mann Whitney U and Spearman's rank correlation test.

Test retest reliability and Inter-rater reliability were found to be adequate for both the clinical and control groups for lexical access tasks and strategies. The results revealed that the clinical group performed similar to the control group on lexical access tasks such as confrontation naming, co-ordinate naming, super-ordinate naming, word naming fluency and generative naming. However their mean scores were lesser than the control group on certain tasks such as co-ordinate naming, super-ordinate naming and word naming fluency. There was no statistically significant difference found in any of the task. There was no correlation found between performance in any of task and cognitive functions and duration of disease. There was a strong significant correlation between the lexical access strategies of switching and cluster size and duration of disease. Hence it can be concluded that the persons with remitting-relapsing type of MS have lexical access abilities similar to the age matched healthy-individuals. However lexical access strategies such as switching decline with increasing duration of disease in persons with MS.

5.1 Implications

The results of the present study provide insight into the lexical access abilities in persons with MS. The results throw light on the decrease in the lexical access strategies with increasing duration of disease and hence there is a need for inclusion of such aspects in routine evaluation in persons with MS. The inclusion of such aspects in routine evaluation will enable the clinicians to identify the subtle cognitive-linguistic deficits. The persons with MS and the caregivers can also be counseled on the strategies that can be used to compensate for the reduction in such skills. The results emphasizes on the development and inclusion of cognitive-linguistic tools that are sensitive in identifying the cognitive dysfunctions in persons with MS.

5.2 Limitations

The main limitation of the study is the sample size and heterogeneity of the population considered. Hence one must exercise caution while generalizing the results of the study. The neuroimaging findings of the persons with MS also were not considered. This could have been correlated with the performance on the lexical access tasks. An in depth cognitive assessment could have been carried out for the participants in the clinical group.

5.3 Future directions

The present study was a preliminary attempt to identify the lexical access abilities in persons with MS. The results of the present study will serve as an avenue for similar research in future on persons with MS. Similar research has to be carried on a larger sample with different types of MS in a systematic way. Longitudinal studies have to be considered in order to evaluate the effect of duration of disease on such lexical access strategies. Future studies can also be carried out to correlate the lexical access abilities with the findings of neuroimaging.

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