NOUN AND VERB PROCESSING IN BILINGUAL MALAYALAM-ENGLISH INDIVIDUALS WITH APHASIA

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ALL INDIA INSTITUTE OF SPEECH AND HEARING

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JUNE, 2011

CERTIFICATE

This is to certify that this dissertation entitled "***Noun and Verb processing in Bilingual Malayalam-English individuals with Aphasia***" is the bonafide work submitted in part fulfillment for the degree of Master of Science (Speech - Language Pathology) of the student (Registration 09SLP017). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CERTIFICATE

This is to certify that the dissertation entitled ***"Noun and Verb processing in Bilingual Malayalam-English individuals with Aphasia"*** has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier in any other University for the award of any Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled ***"Noun and Verb processing in Bilingual Malayalam-English individuals with Aphasia"*** is the result of my own study under the guidance of Dr. Shyamala K.C, Professor in Speech Language Pathology, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier in any other university for the award of any diploma or degree.

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INTRODUCTION

The term “Aphasia” refers to a neurological disorder resulting from damage to those regions of the cerebral hemispheres that form the anatomical basis for the human capacity for language (Goodglass & Kaplan, 1981). The definition was modified in 2001, and stated that “Aphasia refers to the disturbance of any or all of the skills, associations and habits of spoken and written language produced by injury to certain brain areas that are specialized for these functions”. In this definition, the authors assumed that language is localized. The main two schools of thought on the classification system of aphasia include the localizationist and the antilocalizationist view. Localizationist view supports the claim that all type of linguistic behavior can be localized in a particular part of the brain and Antilocalizationist view states that the brain is an integrated unit and damage to any part will affect the functioning of a brain as a whole. The present study is in harmony with localizationish point of view.

The animate and inanimate conceptual categories represent evolutionarily adapted domain-specific knowledge systems in the brain that are subserved by distinct neural mechanisms, thereby allowing for their selective impairment in conditions of brain damage. Categories of words may be differentially affected in brain lesions (Robinson, Grossman, Tammy White-Devin, & D'Esposito, 1996). Not only semantic categories (first of all living and non-living items) but also grammatical classes (that is, nouns and verbs) may be selectively damaged or spared in patients with lesions involving different cerebral areas.

There have been many studies that explained the neural representation of nouns and verbs. Most of these studies were supported by neuroimaging techniques. Nouns and verbs form two major grammatical classes of words in a given language. A

verb indicates the occurrence or performance of an action or the existence of a state and a noun refers to a person, place or thing (Collin's English Dictionary, 1998). Verbs are different from nouns in ways that go beyond their syntactic privileges. Verbs are harder to remember, more broadly defined, more prone to be altered in meaning when conflict of meaning occurs, less stable in translation between languages, and slower to be acquired by children than nouns (Gentner, 1981). Verbs are morphologically more complex than nouns in most languages. They also differ along the semantic detention. That is, nouns tend to represent objects and are more concrete whereas verbs tend to represent actions and are abstract (Chiarello, Shears & Lund, 1999). Further, nouns tend to have more perceptual properties in comparison to verbs. It has been well established that concrete words have a processing advantage over abstract words in different tasks (de Groot, Dannenburg, & van Hell, 1994). Such fundamental differences often make a direct comparison of these two grammatical classes of words quite difficult.

The disproportionate impairment of certain aspects of language in brain damage patients are valuable source of knowledge for understanding the mental organization of linguistic representations. Some of the most relevant information when testing theories about the organization of lexical representations in the brain comes from the study of brain-damage individuals that show a disproportionate impairment for one type of words in comparison to other types. In this context, the grammatical category-specific deficits for nouns and verbs have played an important role. Grammatical category-specific deficits refer to those cases in which patients exhibit a disproportionate impairment or dissociation for the processing verbs vs. nouns or vice versa (Berndt et al., 1997). That is, greater impairment is seen in words belonging to one grammatical category in comparison to the words belonging to other

grammatical categories (Cano et al., 2010). Noun and verb processing deficits have recently become a topic of interest among psycholinguists, researchers into language acquisition and aphasiologists (Druks, 2002). There is also recent upsurge in research interest in verb processing and also in the possible differences in terms of processing between verbs and nouns.

Neuropsychological studies of patients with selective deficits for nouns or verbs have been taken as evidence for the neural specialization of different word classes. Noun deficits are associated with lesions in anterior temporal regions while verb deficits arise from left inferior frontal lesions (Goodglass, 1966; Damasio and Tranel. 1993; Daniele *et al.* 1994). Many Neuroimaging studies have been done in this area of research. But PET study by Lorraine et al. (2001) do not support this claim and state that the meanings of nouns and verbs are represented within an undifferentiated cortical network which is not divided by category or domain. Damage to left posterior, temporal and Occipito-Parietal cortices; does not compromise verb retrieval (Antonio R.Damasio and Daniel Tranel, 1993). The systems essential for verb retrieval were in left frontal cortices. The rationale for this hypothesis came from the observation that damage to left frontal cortices impairs the retrieval of verbs more markedly than the retrieval of nouns, an observation supported by studies in which verb retrieval was more defective than noun retrieval in aphasics with presumed left Front-Parietal damage. Studies in English and Italian languages have shown that non-fluent Broca's aphasics find it more difficult to produce verbs than nouns, while some fluent patients (including Wernicke's aphasics and anomics) show the opposite profile. Explanations for this double dissociation include grammatical accounts from many studies (e.g. verb deficits reflect differences in morphological and/or syntactic complexity), semantic-conceptual accounts (e.g. verbs

are based on action meanings, which are stored in anterior motor regions; nouns are based on object meanings, which are stored in sensory cortex), and lexical accounts (verbs and nouns are stored in separate regions of the brain, independent of their semantic content). From an anatomic point of view, an impairment of nouns tends to correlate with damage to more posterior areas (Temporal areas), while a disproportionate impairment for verbs tends to originate more often from damage to frontal areas of the left hemisphere (Shapiro and Caramazza, 2003). Goodglass, Klein, Carey, and Jones (1966) were the first to report that a group of fluent (Anomic and Wernicke's) individuals had more difficulty; naming objects than naming actions, whereas the reverse pattern was observed in patients with a lesion in the left frontal lobe. This double dissociation has since been confirmed in a number of studies in different languages (e.g., Berndt, Haendiges, & Wozniak, 1997; Breedin, SaVran, & Schwartz, 1998; Chen & Bates, 1998; Damasio & Tranel, 1993; Daniele, Giustolisi, Silveri, Colosimo, & Gainotti, 1994; McCarthy & Warrington, 1985; Zingeser & Berndt, 1988, 1990).

Since most people in the world know more than one language, bilingual aphasia is an important line of research in clinical and theoretical Neurolinguistics. From a clinical and ethical viewpoint, it is no longer acceptable that individual with bilingual aphasia be assessed in only one of the languages they know. According to current linguistic, psychological, and Neurolinguistic approaches, the term "bilingual" refers to all those people who use two or more languages or dialects in their everyday lives (Grosjean 1994). According to Paradis (2004) bilinguals may be classified as early, late or adults, if they started learning the second language before age 6, after age 6, or after puberty, respectively. The notion L1 and L2 is used to refer the first and the second language respectively.

Till date the term bilingual/bilingualism, even has not been defined comprehensively. This is merely because the scope and wings of bilingualism are far too many to be clubbed under a single definition. Many researchers have given various definitions to the term bilingualism. "Bilingualism is native-like control of two languages" (Bloomfield, 1933). According to Haugen (1953a) Bilingualism is learning at the point where the speaker of one language can produce complete, meaningful utterances in the other language.

At least 50% of the world's population is bilingual and this number is increasing (de Bot, 1992). One important question is how brain damage impacts on the patterns of aphasia observed in the languages of a bilingual speaker. Language type constrains these patterns of aphasia (Nilipour & Paradis, 1995). Other constraints are language status, i.e., whether a language is acquired first (L1) or acquired later (L2) and language dominance, which describes the most familiar language used premorbidly (Paradis, 2008). Variables such as word frequency, imageability, and age of acquisition as well as cognate status - i.e. whether words have similar form and meaning across languages, e.g., blue/bleu in English and French - also impact on patterns of bilingual aphasia. The language recovery of bilingual Friulian-Italian aphasics was investigated (Franco Fabbro, 2001). 65% of patients showed a similar impairment in both languages (parallel recovery), 20% showed a greater impairment of L2, while 15% showed a greater impairment of L1.

The present study will be focusing on the noun and verb processing in individuals with bilingual aphasia particularly with anterior and posterior lesions. The reason for considering anterior and posterior aphasia is to find out whether type of aphasia has anything to do with anatomical sites, and secondly whether the bilinguals have the same anatomical structure as monolinguals. Studies in English and Italian

have shown that non-fluent Broca's aphasics find it more difficult to produce verbs than nouns, while some fluent patients (including Wernicke's aphasics and anomics) show the opposite profile. The principles governing the organization of lexical representations in the brain are similar for the two languages of a bilingual (Mireia Hernandez, Albert Costa, Nuria Sebastian-Galles, Montserrat Juncadella, Ramon Rene, 2006).

There are many studies showing a dissociation in noun and verb processing in monolingual aphasic individuals across a number of different languages (e.g., Bates, Chen, Tzeng, Li, & Opie, 1991; Berndt, Mitchum, & Haendiges, 1997a, Berndt, Haendiges, Mitchum, & Sandson, 1997b; De Bleser & Kauschke, 2002; Jensen, 2000; Jonkers, 1998; Laine, Kujala, Niemi, & Uusipaikka, 1992; Luzzatti et al., 2002; Osman-Sagi, 1987; Tsapkini, Jarema, & Kehayia, 2001, 2002). However, there have been only limited studies of noun and verb processing in bilingual individuals with aphasia (Kremin & De Agostini, 1995; Sasanuma & Park, 1995). Bilingual aphasia provides an important avenue to investigate whether any dissociation between the processing of nouns and verbs is confined to only one of the bilingual individual's language or not, in other words whether any differences in noun and verb processing are language or non-language specific. Maria Kambanaros and Willem van Steenbrugge (2006) stated that there are no specific noun or verb impairments in word comprehension in bilingual individuals with anomic aphasia. Noun production was significantly better than verb retrieval in the bilingual individuals with anomic aphasia. This verb-noun dissociation in word retrieval was not language-specific and the effect was larger in L2.

Many studies are supporting the claim of dissociation in noun and verb processing in normal and monolingual individuals with aphasia across a number of

different languages. However, there have been limited studies of noun and verb processing in individuals with bilingual aphasia and there are no studies in Indian context. Most of the studies have been conducted with the evidence from Neuroimaging techniques. The present study is an attempt to find out whether there is any dissociation between the two grammatical categories of nouns and verbs and also to find out the language influence on the individuals with aphasia while producing these two categories. Study of noun and verb processing in individuals with bilingual aphasia would help speech language pathologists to screen or evaluate and rehabilitate them for their speech and language deficits and also the results of the present study will help to provide a better insight into the nature of noun and verb processing in bilingual individuals with anterior and posterior aphasia. Hence the present study throws light into the debatable concept of noun and verb dissociation. It would either support the claim of noun and verb dissociation in individuals with anterior and posterior aphasia or disprove it and would give an idea of noun and verb processing in bilingual individuals with anterior and posterior aphasia. The current study employed reaction time paradigm to find out the

1) Noun and verb processing in Malayalam-English bilingual individuals with anterior and posterior aphasia.
2) To compare the similarities and differences between the individuals with bilingual aphasia and normal individuals for the processing of nouns and verbs.
3) The effect of L1& L2 in the processing of nouns and verbs.

Chapter II

REVIEW OF LITERATURE

The term bilingualism, even to this day has not been defined comprehensively. This is simply because the scope and wings of bilingualism are far too many to be clubbed under a single definition. However, scholars from a variety of fields like linguistics, sociology, anthropology, psychology, speech language pathology etc. have defined and classified bilingualism on the basis of their respective body of work and research methodological requirements. Several researchers gave various definitions of the term bilingualism. Bloomfield (1933) stated that Bilingualism is “native-like control of two languages”.Since most people in the world know more than one language, bilingual aphasia is an important line of research in clinical and theoretical neurolinguistics. From a clinical and ethical viewpoint, it is no longer acceptable that individual with bilingual aphasia be assessed in only one of the languages they know. According to current linguistic, psychological, and neurolinguistic approaches, the term "bilingual" refers to all those people who use two or more languages or dialects in their everyday lives (Grosjean 1994). According to Paradis (2004) bilinguals may be classified as early, late or adults, if they started learning the second language before age 6, after age 6, or after puberty, respectively.

The basic questions in the neuropsychology of bilingualism are whether the two languages of the same subject have different cerebral representations and whether the fact of having acquired two languages influences the cerebral organization of higher cortical functions. Several hypothesis have been proposed, each based on some isolated observational data and much speculation. Most theoretical claims still await empirical validation. One of the earlier claims was that the monolingual was superior

compared to the bilingual. The bilingual was considered to have a single brain divided for two languages. Gradually this view was refuted and the view that a bilingual was two monolinguals in one gained prominence.

First there was the longstanding neurological claim that all languages of a polyglot are subserved by the same cortical locus or loci. A more recent theoretical theoretical linguistic position assumes that all languages share the same linguistic principles and that therefore the underlying cerebral representation must be the same for all the languages of a speaker hearer. It predicts that if some aspect of competence is impaired by neurological trauma then all languages known by the speaker must be disordered in just the same way, consistent with the impaired competence. Thus according to this hypothesis there is no specific cerebral representation for each language but a single undifferentiated capacity for language in general.

Questions specific to bilingual aphasia are added to those stemming from aphasia in general such as whether aphasia is a general cognitive deficit or a language specific impairment, whether it is unitary phenomenon or admits of multiple syndromes, whether it is a deficit of competence or performance and whether modality specific deficits are aphasic syndromes. Theoretical positions on these issues will have consequence for hypothesis about bilingual aphasia and/or the representation of two languages in one brain.

Aphasia refers to the disturbance of any or all of the skills, associations and habits of spoken and written language produced by injury to certain brain areas that are specialized for these functions (Goodglass & Kaplan, 2001). Anterior aphasia and posterior aphasia are two broad classification system of aphasia. Anterior aphasia is synonymous with motor aphasia and posterior aphasia is synonymous with sensory

aphasia. Another synonym for anterior aphasia includes expressive aphasia, Broca's aphasia, non fluent aphasia etc and posterior aphasia includes fluent aphasia, impressive aphasia, psychosensory aphasia, receptive aphasia, Wernicke's aphasia etc. Anterior aphasia is associated with left frontal brain damage and "agrammatism": syntactic impairments in both expressive and receptive language, and the omission and substitution of inflections (e.g. past-tense) and function words (e.g . auxiliaries, determiners). Posterior aphasia is associated with left temporal brain damage and it is the form of aphasia in which there is impairment in the comprehension of spoken and written words, associated with effortless, articulated, but paraphrasic, speech and writing; malformed words, substitute words, and neologisms are charcteristic. "paragrammatism" is seen in this type of aphasia. When severe, and speech is incomprehensible, it is called jargon aphasia. The patient often appears unaware of their deficit.

History of the study of aphasia in bi/multilinguals:

The Early Days

The late nineteenth century marked a period of intense debate focused on answering questions of language representation in the brain. Studies by Paul Broca (1865) and Carl Wernicke (1874) helped correlate clinical manifestations with pathological events in the brain. Most early observations that followed these pioneering researches were taking place in Europe, where most people spoke more than one language or dialect. This led to the question regarding the representation of more than one language in the brain. Evidences for hypotheses related to multilingual cerebral organization came from reports of recovery of some bilingual and polyglot aphasics. More importantly, neurologists began reporting unusual recovery patterns in patients who had spoken two or more languages before their aphasia but showed

differential recovery patterns for each language after an aphasia-producing incident. There might have been many cases of multilingual aphasia that were not specifically reported due to the recovery of multiple languages not being differential. Paradis (1978), in a personal communication to Albert, Goodglass and others said that in terms of incidence, the variant cases may be exceedingly rare; of the tens of thousands of cases of dysphasia in polyglots which must have occurred in the past 150 years, about 135 cases of atypical dysphasia have been reported in all of the available world's literature in any language.

Separate Language Centers

Scoresby-Jackson (1867) came up with one of the earliest explanations regarding differential recovery hypothesizing that each language has separate brain representation or 'language centres' and recovery depends on the centre that is disrupted. He maintained that Broca's area was responsible for the representation of a subject's mother tongue, whereas the portions anterior to the Broca's area were responsible for the representation of the foreign language. The strongest form of this hypothesis has been refuted; however, more flexible versions are retained based on recent imaging studies' evidences (Abutalebi, Cappa and Perani, 2001 etc.). Kim et al. (1997) remarked that Scoresby-Jackson was misinterpreted by his contemporaries and that he had referred to the capacity of the tissue adjacent to Broca's area to control further linguistic functions and did not mean an increase in their anatomical extension.

Theodule Ribot

During 1880s, another explanation was found to be appropriate in describing the pattern of recovery in most cases. This general theory of memory disorders by Theodule Ribot (1881) which stated that earlier learned items are better preserved,

and that, in recovery from memory loss, earlier learned items return before items learned later in life, was applied in the context of language recovery. It was also called the 'rule of Ribot' or 'primacy rule'. Explaining the same, it was opined that the mother tongue is not only a linguistic habit acquired early but presumably built up with more emotional meaning thereby increasing its relative strength.

Pitres' Legacy

A significant step forward in the area was Jean-Albert Pitres' 1895 study of seven bi- or multilingual aphasics. He rejected the notion of separate language representations in the brain for each language by pointing out that each language would need atleast four distinct cerebral centres (two sensory centres: for auditory and visual images and two motor centres: for graphic and phonetic motor images), making it very unlikely that lesions would be distributed in such coordinated fashion. This argument was made on the lines of the conclusions drawn in his study regarding recovery that "after being general at the outset, aphasia regresses progressively. The patient first begins to understand, then to speak the language that was most familiar to him/her. Later on, s/he recovers the ability to understand and then to speak the other languages that s/he knew." This is called the 'Pitres' law' or principle of 'habit strength'. He pointed out that patients during recovery initially go through a stage of 'inertia' during which they fail to understand or use all known languages, and that this is due to disruption but not total destruction of their language centres. He contended that the most familiar language (most frequently and intensively used before damage) reappears first because it is the one that uses the most solidly established associations. He drew attention to the fact that in aphasics, comprehension is often recovered before expression, in each language. Thus Pitres substituted the notion of antecedence (Ribot) with intensiveness. Pitres refined the rule of Ribot noting that most often; the

most familiar language is the mother tongue, due to which the primacy rule may appear to be a sufficient explanation, but when the mother tongue is not the most intensively used language, the primacy effect would not explain preferential recovery. Pitres also distinguished between 'loss' and 'inhibition' and said that in some cases brain lesions destroy linguistic knowledge, whereas in other cases they block the access to this knowledge.

Minkowski (1927) also supported Pitres' rejection of separate neuro-anatomical centres for each language in the bilingual's brain. He proposed that within a common area, active elements from known languages combine and interact at a linguistic level. He also pointed out that systems should not be viewed as destroyed, but as weakened. Studies on unilingual aphasia in the 1870s had described the aphasic symptoms as a reflection of the reduced level of activation of the language system (Hughlings & Jackson, 1879; Freud, 1891/1953). On these lines, the idea was expanded for polyglot aphasics; that, later learned languages are superimposed on the first-learned language, and destruction through lesions results in greater impairment of the later-learned language. The degree to which the later-learned language is used and the age of its acquisition were also considered by Freud as important factors in determining which language is preserved following a lesion.

Thus, it was concluded conservatively that aphasia can have various effects on the bilingual's languages, the particular post-aphasic pattern probably depending in some complex fashion on: the order of language learning, comparative skill levels, affective levels and more. Pitres' report and the subsequent supporting and contradicting evidences opened the gates of a century of research on bi/multilingual aphasia aimed at addressing which language is first to return subsequent to cerebral lesion and why.

Bilingual Behavior and Aphasia

Bilinguals have been to found to switch between languages when communicating with other bilinguals. This phenomenon called 'code switching' (Clyne, 1980; Poplack, 1980), as a normal phenomenon has been classified and sub-classified in sociolinguistic literature. Penfield and Roberts (1959) were the first explicitly to propose the idea of a language switch in the brain. They described it as a device that is 'curiously automatic' and has the effect of turning one language 'off' when the other is 'on'. Grosjean's (1997, 2001) conceptualization of a "language mode continuum" describes a range of forms of language mixing that can occur, depending on the "language mode" a bilingual is speaking in. According to Grosjean (1989), a speaker may use monolingual or bilingual modes. In the former, bilinguals deactivate the language not known by the monolingual listeners (It does not imply that bilinguals always operate in this mode with other monolinguals. Also, it has been found that it is impossible to completely inhibit one language when processing the other (Colome, 2001; Francis, 2005). In the latter, as the listeners are also supposedly bilingual, they activate both languages and mix them in various ways. The levels of activation of different languages are supposed to depend on factors such as the local language environment, the knowledge of the other speakers, the demands of the processing task, and the proficiency of the speakers. While operating in the bilingual mode, if the person is less proficient, they would require greater control of the first language when operating in the second language, which would otherwise lead to intrusions from the dominant language.

The study of such bilingual behavior/s (including translation) took a new turn when data from polyglot aphasics were combined for interpretation. In his 1895 paper, Pitres' had not reported of language mixing; although several researchers of

the times that followed did opine that language mixing was very frequent in polyglot aphasics. The literature from Germany in the 1920s uses the term 'Polyglotte Reaktionen' to indicate the same. Based on certain initial reports, three types of polyglot reactions were distinguished. Balint (1922) reports a client who when requested to say the names of the months in German, said the first few in German and then continued inn Greek. This type of a reaction was categorized as an 'unexpected language switch'. Kauders (1929) reported a client whose verbal output consisted of German sentences interspersed with French and English. Such mingle-mangle of phrases, words and morphemes were grouped under 'linguistic interferences'. Two types were noticed in this category: mixing occurring within words (lexical interferences) and using sentences in a language according to the rules of the other language (syntactical interferences). Veyrac (1931) observed that polyglot patients may also spontaneously translate some of their utterances or they may translate verbal commands before, or instead of, executing them. These were called 'Spontaneous Translations'.

Paradis (1977) explains the possible cortical correlates underlying the switch mechanism on the lines of three basic theories.

1. The unrecovered language is not lost but inhibited. Thus, functional disturbances (Pitres, 1895) (language is not forgotten as such, but only inhibited either permanently or temporarily - Kainz, 1960) may be responsible on the basis of the general laws of excitation, interference, and inhibition between neural phenomena of any kind (Minkowski, 1963).
2. There is a locus in the brain that acts as a switch mechanism which allows the patient to shift from one language to another. Potzl (1925) found a correlation between damage to the left supra-marginal gyrus and selective

recovery concluding that this area has something to do with multilingualism and the gift of tongues, and Kauders (1929) agreed that this cortical area appeared to play the role of a 'distributing device', allowing transition from one language to the next. Leischner (1948) supported the earlier explanations, on the basis of autopsy studies that superior linguistic capacities have an anatomico-physiological correlate in a highly developed configuration and increased surface of the posterior parts of the second and third temporal convolutions, and suggested that damage to this region causes the patient to either speak only in one language or to switch involuntarily from one to the other. This was however, not readily accepted by authors like Goldstein (1948) and Jakobson (1955) who opined that the capacity of maintaining switching is preserved only if the faculty of abstraction is preserved and not necessarily localized to one area. They said that any cerebral lesion impairs switching between mental processes and this is one such example.

3. Each language is stored in a different location in the brain, and this has been debated extensively to date.

Perecman (1984) estimated that language mixing occurs in less than 10 percent of multilingual individuals with aphasia, and more often in Wernicke's aphasia than other syndromes. She tried to differentiate aphasic language mixing from non-aphasic mixing. 'Lexical level mixing' such as word borrowing, occurs in both groups where as 'utterance level mixing' is a phenomenon of aphasia alone. She also noted that translation abilities are peculiarly affected in polyglot aphasics. She analyzed and classified the various types of mixing phenomena in aphasic polyglot patients. Some are: Word mixing – when a patient can't find a word due to anomia,

they are likely to substitute with a corresponding word in the other language. This may be with or without awareness; Root and suffix mixing – using words with roots in one language and affixes from the other; Blending of syllables from different languages within the same word; Use of syntax from one language and lexicon from the other; Intonation of one language and lexicon of the other; Utterance of a word in one language but pronouncing the phonemes in another language (saying 'take' as /t̲aek/); Tendency to answer in a language different from the one in which it is asked. She continued her work and explained the phenomenon using a neurolinguistic model based on the psycholinguistic model of sentence production developed by Garrett in the 1980s. Based on this model, she suggested a classification of mixing phenomena in the following types: lexical-semantics, syntactic, morphological and phonological and correlated each type to one of the stages of Garrett's model (message level, functional level, positional level and phonetic level respectively).

Fabbro (1999) compiled and analyzed existing research data and provided a clear description of classification of bilingual behaviors of polyglot patients. He states that two pathological disturbances are relatively central to bilingual aphasia and they are pathological switching and mixing. The former phenomenon was found to be associated with lesions to the anterior structures of the frontal lobe. Switching errors could be that of pathological fixation on one language owing to the inability to select the other language or spontaneous switching errors evidenced as frequent and uncontrolled switching to another language during the production of sentences. Forster (1936) even reported a polyglot client showing intra-operative spontaneous switching, during a surgery to remove a tumor in the third ventricle; which was triggered by the surgeons' words to the nurse and was also influencing phonologically. The patient did appear to want to convey some information, but could

not form appropriate and coherent sentences although the sequences of words were linked by assonance and/or alliteration. Mixing has been described as occurring when sentences containing elements from different languages are produced. Most often, this occurs as a normal phenomenon; and is seen at a higher frequency and with some unusual errors in the brain damaged (Grosjean, 1989). Fabbro claims that in bilinguals, during verbal expression, the selected language exerts a functional inhibition on the non-selected languages (reciprocal inhibition); and during comprehension, both languages may be activated, because messages in different languages may be understood at the same time.

Language Competence and Performance

The question of whether aphasia is a loss of competence or performance has been discussed extensively in the context of bilingual manifestations. Some authors (Scholes, 1984) believe that competence should be considered unimpaired if the deficit is not manifest equally in all the languages of an individual because competence is considered common to all languages. Thus, what recovers spontaneously in any patient and what is differentially deficient in bilinguals is not considered a result of impaired competence but of loss of access through some defective performance mechanism. However, there are also no compelling evidences to show that there is only one underlying neurolinguistic competence for both languages either.

Language Organization in the Left Hemisphere

Whatever the participation of the RH, the question remains as to how two languages are represented in the same brain. As a result of his extensive studies of

bilinguals with disordered language functions (aphasics) Paradis (1981/87) wrote the following 5 hypotheses about the representation of their languages.

1. Extended System Hypothesis: Here, the languages are undifferentiated, and the elements of the two languages are processed as 'allo-elements'. Parallel recovery, ability to understand both languages even while speaking or writing in one, and the ability to assume a foreign accent on the structure of a native language all support this hypothesis.
2. Dual System Hypothesis: Here, each language is represented independently in separate circuits. Selective recovery or any other type of non-parallel recovery could be explained using this view.
3. Tripartite System Hypothesis: Here, items that are identical in both languages are represented in a single underlying neural substrate; those that are different each have their own separate representation. Evidence from electrical cortical stimulation in bilinguals reported by Ojemann & Whitaker (1978) and Rapport et al. (1983) is compatible with this hypothesis, where at some stimulation sites both languages were affected and at others only one was.
4. Subset/Subsystem Hypothesis: Here, bilinguals have two subsets of neural connections, one for each language, within the same cognitive system called the 'language system'. It is a very comprehensive hypothesis that can account for most patterns of recovery.
5. Context of Acquisition Hypothesis (cited in Mildner, 2008): Languages that are acquired in different contexts are neurofunctionally more separately represented than those acquired in the same context.

Languages with Structural Similarities

In an attempt to answer the question whether similarity of structure between two languages of a bilingual has any impact on their cerebral organization and hence on the pattern of recovery in aphasia, Albert & Obler (1978) proposed that the proximity of structurally similar languages may entail 'effort' to avoid interference, leading to more separate neural structures. In this perspective, one might expect languages that are similar to be recovered more differentially than languages whose structural distance is sufficient not to require this 'effort' and consequent greater neurofunctional separation. On the other hand, the opposite argument can be put forward: the less two languages have in common, the more they are represented separately. It could be assumed that features common to two related languages would not be redundantly represented but would form a single representation shared by both languages, whereas unrelated languages would de facto have greater neurofunctional separation since they would hardly have any features in common. A third possibility is of course that structural distance is irrelevant and that as long as two languages are spoken, they are subserved by separate neural substrates (Paradis, 1987).

Lexical and Conceptual Representations

One of the major problems in understanding the polyglot/bilingual brain has been the failure to distinguish between the meaning of words (lexical semantics) and non-linguistic mental representations (concepts). From the days of Weinreich (1953) when he posed the question, "do translation equivalents have the same meaning for a given speaker?" and identified the three types of organization (subordinative bilingualism, compound bilingualism and coordinative bilingualism – 'coordinative' and 'subordinative' were soon replaced by 'coordinate' and 'subordinate' in subsequent literature), experimental psychologists and several others have

investigated whether bilingual speakers possess two linguistic memory stores or one (Kolers, 1963/68/77; McCormack, 1974 etc). Ervin & Osgood (1954) shifted the scope to a psycholinguistic level by relating the type of organization to the context of acquisition. Eventually, the scope of the investigations was narrowed down as a whole to the speaker's "internal dictionary" (Neufeld, 1973) or "bilingual mental lexicon" (Schreuder & Weltens, 1993).

Most studies adopted the assumption that if subjects responded to translation equivalents in the same way as they responded to the repetition of the stimulus word, the one store hypothesis holds good; and if they responded to translations equivalents in the same way as they responded to altogether different words in the same language as the stimuli, the two store hypothesis holds good. Kolers (1968) confirmed that none of the studies confirm the one- or two-store hypothesis. Responses were too similar across languages to support the two store version, but not similar enough to accept the one store hypothesis. The experiments done on the above lines were all difficult to interpret in a concrete manner considering the problems related to classification/grouping of participants, individual variability of the participants, differential effects of the stimuli on different participants etc. However, translation equivalents were in fact found to trigger more or less equivalent responses as synonyms in the same language. Paradis' (1980) three store hypothesis accommodated these results. He said that the semantic field of each word is determined by language-specific constraints on its possible uses. Words share some but not all of the semantic features of their translation equivalents and will therefore not denote all of the same referents. The mental representation that corresponds to a word will thus differ to some extent from the mental representation corresponding to its translation equivalent. But, the speaker has only one system of mental

representations, which constitutes a third memory store, namely that of concepts. Each language organizes the mental representations in accordance with its own lexical semantic constraints.

This distinction has helped in explaining aphasia patterns across languages and the relative preservation of concepts (Hecaen, 1968; Lecours & Joanette, 1980). Paradis said that the third cognitive system, phylogenitically and ontogenetically anterior to the language systems, is independent of language and hence the many languages of a polyglot, and remains available to the patient. Several researchers (Beauvois & Derouesne, 1976; Gardner & others, 1976; Zurif & Blumstein, 1978; Velletri, Gazzaniga & Primack, 1973) had already recognized that in spite of massive language loss (even global aphasia) patients retain a rich conceptual system. Thus, one can distinguish between the lexical meaning of words, a part of the speaker's linguistic competence (a component of the lexical item, together with its syntactic features and phonological form), and hence vulnerable to aphasia, and conceptual representations which are outside of implicit linguistic competence and are not vulnerable to aphasia. Some concepts would be less easily verbalizable in one or the other of the patient's languages by virtue of the language system itself; thus leading to differential impairments.

Linguistic and Neurolinguistic Descriptions

Paradis (1995) explains the difference between the linguistic and neurolinguistic explanations for bilingual language representation on the basis of evidence from aphasia. The earliest thought that the organization of the neural substrate is in some way modified as a consequence of the differential organization of the differential organization of language structure has been refuted. Lambert & Fillenbaum (1959) had supposed that compound bilinguals would store their

languages in ways that are more neurofunctionally similar, while coordinate bilinguals would store their two languages in more neurofunctionally separate ways. Polyglot aphasics showing different recovery for languages learnt at the same time in a bilingual environment and parallel recovery for languages learnt in two different situations are evidences against the original idea.

Paradis said that different cerebral processes may yield the same linguistic output, and the same cerebral processes may yield different linguistic outputs. The accuracy (with respect to the unilingual norm) of the languages spoken by an individual is independent of the manner in which they are processed by the brain. In a study reported by Weber-Fox & Neville (1994/96), they found that an early bilingual may possess close class words in the same way as unilingual native speakers, even though the use of some of these words may be deviant with respect to the norm, whereas a late bilingual may use each language with native-like accuracy, although processing close class words in a manner that differs from unilinguals' and early bilinguals', as evidenced by event-related potentials. Thus, different cerebral processes may yield the same linguistic output, and same processes may yield linguistic output that differs from the norm and from one individual to another.

Paradis opined that linguistic and neurolinguistic domains of discourse bear on different objects, the nature and internal structure of which are independent of each other, and hence the particular form of the linguistic elements has no bearing on the neural principles that govern its substrate. What happens at a higher level does not condition the ways of functioning at the lower level. The domain of the linguistic level is the structure of language, implicit linguistic competence, the grammar. The domain of the neurolinguistic level pertains to the anatomical areas, brain mechanisms and physiological processes involved in the storage and use of language. The

neurobiological level is concerned with the properties of cells and the actions of chemicals, hormones, enzymes, vitamins, cell metabolism and the like. The molecular level is concerned with the nature of the particles that are at the basis of brain matter, and their motion. Even though each level is subserved by the level below it; the internal structure and functioning of each level is different from those of the next level since each level consists of different types of entities that are subject to different laws. Thus, what makes a particular item available depends on the activation threshold of its underlying neural substrate, which in turn depends on the frequency of activation of that item. But, the grammatical nature of the item is irrelevant to the mechanisms that regulate the distribution of neural impulses, or the metabolism that supports the activity of particular cells involved. Thus, each level has its own nature and modus operandi, and while it is, so to speak, at the service of the next level, the way it produces the goods it delivers is totally independent of how these goods are processed at the next level.

Unilinguals versus Polyglots

An attempt to understand the differences between unilinguals and polyglots has been made since the earliest reports of bilingual/multilingual aphasia, particularly from a neuro-psycholinguistic perspective. The opinions have been waxing and waning over the years; from the times of postulated separate neural anatomy for two/more languages by Scoresby-Jackson, to Grosjean's view that a bilingual is not just two monolinguals in one person, to Paradis' arguments to interpret the differences considering the underlying similarities between them. In addition, evidences from the models of lexical organization in bilinguals (some of them derived from the models meant to explain unilingual language aspects) and acquisition based propositions have all dealt with this issue.

Psycholinguists have come to realize that “most or all processes encountered in bilingualism have a monolingual parallel” (Kirsner, 1986) and that bilingualism is actually “an extreme example of register difference” (Smith & Wilson, 1980). Whatever behaviour that is observed in a bilingual is observed in a unilingual as well, albeit possibly to different extents. Both unilinguals and polyglots have been shown to exhibit mixing, switching, borrowing, interference and translation (Baetens & Beardsmore, 1980).

Language switching, the change from one language to the other, has its counterpart in what sociolinguists call ‘code switching’, namely register shift, dialect shifts etc. in unilinguals. In either case, the shift is determined by social and other contextual constraints. Switching from baby talk to colloquial and from colloquial to formal speech, like switching between languages, results in differences at the phonological, morphosyntactic and lexical levels. Code mixing, that refers to the use of elements of more than one language within the same structure again corresponds to the situation in unilinguals where sociolinguistic register code mixing takes place. Borrowing can also occur in the same manner in both uni- and bilinguals. Translation, or saying in one language a close approximation of what is said in the other language, has its analogy in paraphrasing, either between registers (involving phonology, morphosyntax and the lexicon) or even within the same register (involving only morphosyntax and lexicon).

However, some reaction time studies have shown that bilinguals and trilinguals have longer reaction times for naming than unilinguals (Magiste, 1986). The reason had been attributed to the fact that the combined vocabularies of the many languages contain more entities than the vocabulary of an average bilingual, thus indicating a difference between the two groups. This data is not conclusive yet, in that

research has shown considerable variations even among unilinguals in terms of reaction times, and that the curves for the two groups overlap. Thus, it has been concluded that the relevant variable is the number of lexical items, irrespective of the number of languages (Thus, a unilingual with extensive vocabulary may perform similar to a bilingual with a similar number of lexical items overall). Thus, it is opined that one need not strictly view the number of languages (to set apart a word as belonging to 'English' or 'Sanskrit') as a variable very different from talking styles (to set apart a word as 'baby talk') or grammatical properties (to set apart a word as being a 'noun').

Kescskes & Albertazzi (2007) drew several similarities regarding the representation and processing in bilinguals and unilinguals (explanation based on review of models). They said that the nature of activation in both groups is similar in that the linguistic concept and conceptual representation are evoked by the use of it in a context where only relevant features get activated. Both groups are hypothesized to possess a CUCB. There are similarities in the way the conceptual bases of L1 and L2 develop. In a bilingual, initially, the concepts of L2 overlap with L1 and gradually the overlap ceases to be complete as some features are deleted and others added that it becomes similar to the native L2. In the unilingual, a similar pattern is seen when synonyms add on to the L1 concept. Paradis (1998) said that each language system may impose constraints on how various mental representations can be verbalized, but the process of verbalization (i.e. matching concepts with words) is the same for unilinguals or bilinguals. The basis on which such a choice is made is same whether it is between languages or registers, namely the appropriateness of the situation, given the interlocutors.

Crystal (acquisition based explanation, 2004) conceptualized an innate mechanism called the 'Multilingual Acquisition Device' on the lines of Chomsky's 'Language Acquisition Device', accepting that the innate mechanisms that help children acquire their first language also help them acquire second or subsequent languages in early childhood. On the other hand, bilingual-learning children's more obvious dependence on relatively specific amounts of input from the environment, draw the proposition towards the 'Language Acquisition Support System' of Bruner, 1983. Thus, language acquisition in early bilinguals has been found to be more similar to unilingual acquisition.

Neural Co-relates

Most recent investigations have used sophisticated neuro-imaging/electrical stimulation/evoked potential methods to tap the neural bases of different languages in bilingual aphasics and non-aphasics. The findings of some of the researches are presented here.

Kim and others (1997) found that the spatial pattern of activation on fMRI in Broca's area for the two languages (French and English) in early bilinguals were different from that found in late bilinguals: in early bilinguals the two languages were represented in overlapping areas, whereas in late bilinguals the representations were separate. There were however no differences between the two groups in the Wernicke's area.

Dehaene et al. (1997) found greater right hemisphere activation for L2 stories than L1 in moderately fluent late bilinguals, on ERP. Proverbio et al. (2004) found in their ERP study of simultaneous interpreters that differences in L1/L2 processing was not related to proficiency, but to later acquisition of L2 compared to L1, which resulted in lesser degree of hemispheric lateralization for L2. Chee and others (1999)

found no differences between early and late Mandarin-English bilinguals on fMRI. They found common macroscopic areas to be active during L1 and L2 processing and concluded that the two languages shared one store.

Gazzaniga et al. (2002) conducted ERP studies of 20 month-old babies which revealed that lateralization is correlated with the number of words in their repertoire, not their age. Children with rich vocabulary had left lateralized brain activity while listening to words, where as those with a relatively smaller vocabulary exhibited bilateral activation.

Pouratian et al. (2000) found by means of optical imaging in a balanced Spanish-English bilingual, cortical areas that are common to both languages (superior temporal sulcus, superior and middle temporal gyri, and parts of the SMG) and those that were language specific (in the SMG and pre-central gyrus). The authors concluded that the common areas are important for general language processing and are, therefore not language specific. Such functional distinction between common and language-specific areas of activation does not depend on age of acquisition or level of competence of L2.

Fabbro (1999) compiled the data based on electrical stimulation of specific cortical areas during neuro-surgical operations and made certain conclusions: (1) in all cases of bilingual patients there were cerebral areas common for both languages; (2) at the same time, certain areas, if stimulated, produced interferences only in one language; and (3) the second language tended to have a more diffuse representation in the left hemisphere as opposed to the representation of the mother tongue. The last conclusion has been contradicted by a study in 1990 by Berthier and others who found perisylvian organization of the second language and a more diffuse cortical representation of the mother tongue.

Paradis (1995) said that some cases of pathological switching and mixing of languages show that the mechanisms for language selection and inter-language switching are located in the right hemisphere, although there are cases of left-hemisphere damage with identical consequences. More recently, Hernandez and others (2000) found (by means of fMRI applied during a naming task) such a switching mechanism involves Broca's area, the supramarginal gyrus, and the anterior cingulate gyrus, without differences in the representation of L1 and L2.

Kescskes and Albertazzi (2007) and Paradis (2004) said that the structures that mediate native language learning in an incidental manner and those that support second language learning at school are different. The former uses procedural memory subserved by the right cerebellum, left basal ganglia and the perisylvian cortex areas. The latter uses the declarative memory supported by the hippocampus, the anterior cingulate cortex and the mesial temporal lobes. The pragmatic aspect of the language is generally based in the right hemisphere (Van Lancker, 1997); and affect (motivation and emotion) that is closely related to language specific pragmatics is supported by the amygdala and the dopaminergic system (Schumann & Wood, 2004). The extent to which each aspect may be used may vary under the influence of many factors. Paradis' (2004) central message remains that 'there is no mechanism at work in the bilingual speaker's brain that is not also operative in the unilingual brain'.

Processing of grammatical categories in the brain

Two different theoretical approaches dominate the study of language and its neural representation. One school of thought, derived from the tradition of generative grammar (Chomsky, 1956), stresses the independence of language from other cognitive functions. Scientists working within this tradition attempt to isolate highly specific linguistic deficits and integrate them into the framework of theoretical models of grammar (Rice and Wexler, 1996; Grodzinsky, 1995). The animate and inanimate conceptual categories represent evolutionarily

adapted domain-specific knowledge systems that are subserved by distinct neural mechanisms, thereby allowing for their selective impairment in conditions of brain damage. Categories of words may be differentially affected in brain lesions (Robinson, Grossman, Tammy White-Devin, & Esposito, 1996). Not only semantic categories (first of all living and non-living items) but also grammatical classes (that is, nouns and verbs) may be selectively damaged or spared in patients with lesions involving different cerebral areas.

Functional neuroimaging studies, using PET and functional MRI (fMRI), suggest that conceptual knowledge is represented within an extensive network involving the left lateral temporal lobe, left posterior parietal lobe and left inferior frontal gyrus, possibly including some homologous areas in the right hemisphere (Vandenberghe *et al.* 1996; Mummery *et aL,* 1998). Neuropsychological studies of patients with category-specific deficits suggest that this semantic network might be organized further as a function of factors such as word class. For example, patients have been reported with selective deficits for nouns or verbs, with lesions to anterior temporal regions associated with noun deficits, and left frontal lesions with verb deficits (e.g. Goodglass. 1966; Damasio and Tranel. 1993; Daniele *et al.*. 1994). This neural differentiation is compatible with behavioral studies showing that children and adults appear to treat nouns and verbs differently. For example, they are acquired at different rates, with nouns being learned earlier than verbs (Gentner. 1981; Gleitman. 1994), and adults generally exhibit poorer performance with verbs than nouns on a variety of tests.

There have been many studies that explained the neural representation of nouns and verbs. Most of these studies were supported by neuroimaging techniques. Nouns and verbs form two major grammatical classes of words in a given language. A verb indicates the occurrence or performance of an action or the existence of a state and a noun refers to a person, place or thing (Collin's English Dictionary, 1998). Miller and Fellbaum (1991) argued that verbs form the most important lexical category of a language in English. However, there are certain fundamental differences between nouns and verbs. Verbs are different from nouns in ways that go beyond their syntactic privileges. Verbs are harder to remember, more broadly defined, more prone to be altered in meaning when conflict of meaning occurs, less stable in

translation between languages, and slower to be acquired by children than nouns (Gentner, 1981). Verbs are morphologically more complex than nouns in most languages (Vigliocco et al. 2006). They also differ along the semantic detention. That is, nouns tend to represent objects and are more concrete whereas verbs tend to represent actions and are abstract (Chiarello, Shears & Lund, 1999). Further, nouns tend to have more perceptual properties in comparison to verbs. It has been well established that concrete words have a processing advantage over abstract words in different tasks (de Groot, Dannenburg, & van Hell, 1994). Such fundamental differences often make a direct comparison of these two grammatical classes of words quite difficult.

The disproportionate impairment of certain aspects of language in brain damage patients are valuable source of knowledge for understanding the mental organization of linguistic representations. To this aim, particularly relevant are the grammatical category-specific deficits. Some of the most relevant information when testing theories about the organization of lexical representations in the brain comes from the study of brain-damage individuals that show a disproportionate impairment for one type of words in comparison to other types. In this context, the grammatical category-specific deficits for nouns and verbs have played an important role. Grammatical category-specific deficits refer to those cases in which patients exhibit a disproportionate impairment or dissociation for the processing verbs vs. nouns or vice versa (Berndt et al., 1997). That is, greater impairment is seen in words belonging to one grammatical category in comparison to the words belonging to other grammatical categories (Cano et al., 2010). Noun and verb processing deficits have recently become a topic of interest among psycholinguists, researchers into language acquisition and aphasiologists (Druks, 2002). There is also recent upsurge in research interest in verb processing and also in the possible differences between verbs and nouns.

From the perspective of aphasia research, several studies have documented that verbs and nouns can be differently affected by aphasia. Evidence to support this claim has come from studies describing individuals with aphasia who were able to understand and name nouns better than verbs or vice-versa (Daniele, Giustolisi, Silveri, Colosimo, & Gainotti, 1994; Miceli, Selveri, Noncentini, & Caramazza, 1988; Silveri & Di Betta, 1997) with the same test items. Specifically, an overall reduced ability to access verbs with the preserved ability to name nouns was associated with agrammatism in Broca's aphasia, usually associated with lesions in the frontal area of the left cerebral hemisphere. On the other hand, more pronounced noun retrieval impairments, with verbs preserved, was observed in anomia or fluent aphasia often associated with lesions in the posterior area of the left cerebral hemisphere (Goodglass & Kaplan, 1983). Additional evidence of noun/verb dissociation has come from studies involving individuals with semantic dementia (Breedin, Martin, & Saffran, 1994). Further, the noun/verb dissociation has been found in several non-English speaking-aphasic subjects such as Chinese (Bates, Chen, Tzeng, Li, & Opie, 1991), Dutch (Jonkers & Bastiaanse, 1996), Finnish (Laine, Kujala, Niemi, & Uusipaikka, 1992), German (De Bleser & Kauschke, 2002), and Italian (Miceli, Silveri, Villa, & Caramazza, 1984; Miceli et al., 1988). It is therefore, apparent that the brain damage could selectively impair noun-verb retrieval.

Lexical processing in bilingual brain

A few studies have recently documented cases of proficient bilingual individuals who, subsequent to neural injury, suffered selective deficits affecting specific aspects of lexical processing. These cases involved disruption affecting the production of words from a specific grammatical category (verbs or nouns) or the production of irregular versus regular verb forms. Critically, these selective deficits

were manifested in a strikingly similar manner across the two languages spoken by each of the individuals. The brain-damaged bilingual speakers exhibited selective deficits for nouns, verbs, or irregularly inflected verbs in both of their languages. The selectivity and cross-language nature of the deficits indicates that at least certain language substrates are shared in proficient bilingual people. The fact that these deficits affect grammatical class distinctions and verb inflections, information that is part of the lexicon, further indicates that shared neural substrates support lexical processing in proficient bilingual people.

Case studies by Cholin, Goldberg, Bertz, Rapp & Miozzo, (2007), de Diego Balaguer. Costa, Sebaslian-Galles, Juncadella. & Caramazza, (2004), Hernandez el al. (2008), Hernandez, Costa, Sebaslian-Galles. Juncadella, & Rene, (2007), suggested that individuals who exhibit quite selective lexical deficits affecting such things as their ability to orally name words in a particular grammatical category (nouns or verbs) or their ability to produce morphologically irregular vs. regular verb forms. Critically, these selective deficits are manifested in a strikingly similar manner across the two languages spoken by the individuals. The cross-language and yet lexically selective nature of the deficits indicates that at least certain language substrates are shared in proficient bilingual people. The principles governing the organization of lexical representations in the brain are similar for the two languages of a bilingual (Mireia Hernandez et al. 2006).

Evidences from aphasia

There are few reports in the bilingual aphasia literature that can be clearly identifiedas specifically involving lexical retrieval deficits; that is, deficits that affect the retrieval and processing of word forms. A key component in establishing lexical

retrieval failure is showing that the other processes involved in word production are either intact or not responsible for the critical word production impairment. Critically, both semantic and articulatory or motoric (post-lexical) deficits must be ruled out as the source of the pattern of interest. Therefore, although there may be a number of cases of lexical retrieval deficits in the bilingual aphasia literature, sufficient information is not always provided to allow for a clear localization of the deficit. Data's from grammatical category deficits and lexical retrieval deficits that specifically result in greater accuracy in the production of regular vs. irregular verb forms. These cases all involve highly similar deficits in both languages, providing support for the hypothesis that at least some aspects of lexical representation and retrieval are shared across languages. A German English bilingual individual exhibiting a pattern of greater difficulties with irregular vs. regular verbs in his two languages was reported by Cholin et al. (2007). Studies in English and Italian have shown that non-fluent Broca's aphasics find it more difficult to produce verbs than nouns, while some fluent patients (including individual with Wernicke's aphasia and individual with anomic aphasia) show the opposite profile (Sylvia & Elizabeth, 1999). Explanations for this double dissociation include grammatical accounts (e.g. verb deficits reflect differences in morphological and/or syntactic complexity), semantic-conceptual accounts (e.g. verbs are based on action meanings, which are stored in anterior motor regions; nouns are based on object meanings, which are stored in sensory cortex), and lexical accounts (verbs and nouns are stored in separate regions of the brain, independent of their semantic content).

Studies on noun and verb processing in bilingual aphasia

Evidence from monolingual speakers has revealed that word-forms of different grammatical categories are organized with sufficient independence from one

another such that retrieval of words in one grammatical category can be selectively disrupted. As reported by Almagro, Sanchez-Casas. And Garcia-Albea (2003) in which a Catalan Spanish aphasic speaker is described as having greater difficulties in orally producing nouns than verbs in both languages (although the deficit was more severe in Catalan. LI). A semantic locus was unlikely as this individual exhibited good performance in word picture matching. Although he did appear to have some (post-lexical) articulatory difficulty, this should not have affected nouns more than verbs, and therefore is unlikely to have been the source of the grammatical category dissociation. The finding of such a selective deficit that affects multiple languages clearly provides support for a shared-substrates view of bilingual lexical representation. Two other cases similar to the Almagro et al. (2003) case, and for which we have somewhat more detailed information have been reported by Hernandez, et al. (2007. 2008).

Hernandez et al. (2007, 2008) reported that nouns and verbs exhibit similar morphological characteristics in Catalan and Spanish. In both languages, nouns are marked for grammatical gender and number, while their verbs carry inflections denoting tense, person, and number and are organized within similar conjugational systems. These morphological similarities make the two languages more comparable, facilitating a comparison between them. The inflections taken by the nouns and verbs in the two languages can either be the same (e.g. *-a* for singular, feminine nouns; *-e* for the future tense, first person of verbs) or different (e.g. the suffix *c* is used with present tense, first person singular verbs in Catalan but not in Spanish). Similarities between Catalan and Spanish are also evident at the word-form level with many verb and noun cognates (e.g.. portalpucrta [door], ballarlhailar to dance]). However, the high number of Catalan/Spanish cognates complicates the comparison of responses in

the two languages. Cognates may allow for apparently correct responses in both languages, even if responses were available in only one language. To circumvent this problem, results should be confirmed with words that are unique in each language.

Noun and verb comprehension and production was investigated in two groups of late bilingual, Greek-English speakers by Maria Kambanaros and Willem van Steenbrugge (2005) and found that there were no significant differences in verb or noun comprehension between the two groups in either language. However, verb and noun production during picture naming was significantly worse in the bilingual individuals with anomic aphasia in both languages, which also showed specific verb impairment in Greek and English. The potential underlying level of breakdown of the specific verb impairment was further investigation with reference to two specific features of verbs: instrumentality and verb-noun relationship. Additional results revealed a facilitatory effect of Instrumentality in both languages. However, there was no effect of verb-noun name relation in Greek, and a negative effect of verb-noun name relation was observed in English. Lemma retrieval seemed to be intact in this group of bilingual individuals whose main problem seemed to arise during the retrieval of the phonological representation of the target word. This impairment was greater in English.

Chapter III

METHOD

Research is an endeavor to discover answers to intellectual and practical problems through the application of scientific method. The present research is an exploratory research which is undertaken to explore an area where little is known or to investigate the possibilities of undertaking a particular research study. Many researchers support the localizationist view that is; language is localized in a particular part of the brain. The present research work is focusing on the two main grammatical categories, nouns and verbs. The evidences from previous researches which support the claim those noun deficits are associated with lesions in anterior temporal regions while verb deficits arise from left inferior frontal lesions. The present study is an attempt to find out whether there is any dissociation between the two grammatical categories nouns and verbs and to find out the language influence on the individuals with aphasia while producing these two categories.

The study consists of the following two stages:

Stage 1: The stimuli were presented to the individuals with aphasia and measured the accuracy and reaction time.

Stage 2: The stimuli were presented to the normal controls and measured both accuracy and reaction time.

Subjects

The participant group consisted of ten Malayalam-English speaking late bilingual individuals with anterior (group 1a) and posterior aphasia (group 1p) and the age range is between 40 to 75 years, whose first language (L1) is Malayalam and second

language (L2) is English and 10 non-brain injured Malayalam-English late bilingual individuals (group 2) matched for age, gender and education. The reason for selecting the broad term anterior and posterior aphasia is for the availability of the patients. Among the ten patients five are having anterior aphasia and another five are having posterior aphasia. The subjects include one Broca's , three transcortical motor and one anomic individual with aphasia who had lesion in the frontal lobe that is, in the anterior region of the brain and two transcortical sensory and three Wernicke's aphasia patients who had lesion in the temporal lobe that is, in the posterior region of the brain and also ten normal individuals.

The control group subject selection criteria:

a) They should be clinically non-brain damaged normal bilingual individuals.

b) They should not have had any associated health problems at the time of testing.

c) They should be native speakers of Malayalam.

d) They should have had at least ten years of formal education in English and Malayalam.

Table 3.1: The age, sex, education and number of years of exposure to Malayalam and English language of the normal subjects

Subject	Age	Sex	Education in years	Language exposure in years	
				M	E
1	50	M	20	50	23
2	56	M	18	56	30
3	45	F	15	45	27
4	53	M	19	53	35
5	40	F	20	40	25
6	56	M	17	56	30
7	54	M	13	54	19
8	47	F	17	47	27
9	55	M	19	55	20
10	59	M	15	59	24

Patient selection criteria:

a) The subject should have been diagnosed as having aphasia by a speech-language pathologist or neurologist.

b) Aphasia should be consequent to a Cerebro-Vascular Accident and the lesion site should be in the left frontal or temporal region.

c) Post onset time should be within 1 year after the Cerebro-Vascular Accident.

d) The subject's native language should be Malayalam.

e) They should have had at least ten years of formal education in English and Malayalam.

Table 3.2: The age, sex, post onset time, education, and number of years of language exposure to Malayalam and English and CT scan data of individuals with aphasia

Subject	Age	Sex	Post onset time	Education in years	Exposure language in years		CT scan data
					M	E	
1	75	M	4 months	18	75	57	Left frontal lobe infarct
2	56	F	1 year	15	56	20	Lesion in the left frontal lobe
3	63	F	9 months	17	63	25	Infarct in the inferior frontal gyris
4	70	M	1year	12	70	45	Infarct in the left anterior cerebral artery (Lesion in the frontal lobe adjacent to the Broca's area)
5	45	M	9 months	15	45	18	Left frontal lobe infarct
6	53	M	7 months	16	53	15	Left temporal lobe infarct
7	62	M	5 months	19	62	30	Left MCA infarct (Lesion in the left temporal lobe)
8	56	M	1 year	17	56	25	Left MCA infarct with hemorrhagic (Lesion in the left temporal lobe)
9	70	M	8 months	17	70	50	Infarct in the left MCA territory (Lesion in the temporal lobe region)
10	67	M	6 months	18	67	35	Left temporal lobe infarct

Exclusionary criteria:

a) Patients should not have had any associated health problems at the time of testing.
b) They should not have had any associated conditions like Visual Amnesia and other cognitive neurological condition like dementia.
c) They should not have had any emotional trauma at the time of testing.
d) Patients with multiple strokes were excluded from the study.

Stimuli

Four sets of stimulus material were prepared by an experienced speech language pathologist whose first language (L1) is Malayalam and second language (L2) is English. The four sets are as follows:

Set 1: Consisted of 10 color pictures of nouns which are frequently used in Malayalam.

Set 2: Consisted of 10 color pictures of nouns which are commonly used in both Malayalam and English.

Set 3: Consisted of 10 color pictures of verbs which are frequently used in Malayalam.

Set 4: Consisted of 10 color pictures of verbs which are commonly used in both Malayalam and English.

All four sets of picture stimuli had both Malayalam and corresponding English word which were commonly used in both the languages. Stimuli were selected based on the familiarity and the familiarity was assessed using a familiarity rating scale. It was a four point rating scale with four ratings (3 is most familiar, 2 is familiar, 1 is

least familiar and 0 is unfamiliar). The stimulus was given to normal 20 bilingual Malayalam-English individuals whose native language (L1) was Malayalam and second language (L2) was English.

The following tests and software's were used for the present research work.

Materials

- ✓ Western Aphasia Battery (WAB) (Andrew Kertesz, 1982) and Test of Aphasia in Malayalam (Jenny, E.Philip, 1992) were administered to all the clinical subjects by a qualified speech language pathologist to find out the type of aphasia. They diagnosed as having Broca's aphasia, Wernicke's aphasia; Transcortical motor aphasia, Anomic aphasia and Trancortical sensory aphasia in both the tests.
- ✓ Bilingual Aphasia Test (BAT) English version (*Paradis* & Libben, 1987) and Malayalam version (Annamma George, 1996) were administered to find out the language proficiency and found that all the patients were proficient in their native language that is, Malayalam.
- ✓ International Second Language Proficiency Ratings (ISLPR) (David *Ingram* & Elaine Wylie, 1997) was used to find out the second language proficiency. Most of the patients had basic vocational proficiency in English for the speaking task and they could understand, read and write their second language prior to the onset of stroke as reported by their family members.
- ✓ The stimuli were visually presented in a Lenovo G450 laptop screen through DmDX software and the responses were recorded through a microphone to measure the accuracy and reaction time of each participant.

- ✓ SPSS Statistics 17.0 software was used for statistical analysis.

Procedure

After familiarization of the stimulus, it was presented to a patient with aphasia as a pilot study to set the interstimulus interval in DmDX software. Based on that the inter stimulus interval was kept 3000ms. The data was collected from several hospitals in Kerala. The medium of instruction was Malayalam in Set 1 and Set 3 stimuli and English in Set 2 and Set 4 stimuli. The four sets of pictures were presented in a Lenovo G450 laptop screen with an inter stimulus interval of 3000ms and the pictures were presented through DmDX software. In the first stage of the study the aphasic subjects were instructed to name the picture which was shown in the screen. They were given 3000ms time for responding. For Set 1 and Set 3 stimuli the subjects were instructed to name in Malayalam and for Set 2 and Set 4 stimuli they were instructed to name in English. No prompting was used to help the subjects. The procedure was done in a totally noise free environment with the subjects comfortably seated. In the second stage of the study the above procedure was repeated with a normal control group. The procedure was similar as mentioned for the individuals with aphasia. The responses of all the participants were audio recorded using a microphone which was kept 10 cm away from the subject's mouth. From the recorded sample the accuracy and reaction times were measured.

Analysis

Data was obtained from 3 groups of subjects.

Group 1a: Individuals with anterior aphasia

Group 1p: Individuals with posterior aphasia

Group 2: Normal individuals

Accuracy and reaction time are measured from responses obtained from the subjects. Each set of stimuli consisted of 10 pictures. The accuracy was measured from the number of correct responses obtained from 10 pictures of each set and reaction time was calculated by taking the average of correct responses. The accuracy and reaction time data was analyzed using the following statistical methods

- ✓ Mean and standard deviation for both accuracy and reaction time were calculated.
- ✓ Mann-Whitney Test was carried out for between group comparisons with respect to accuracy and reaction time.
- ✓ Kruskal-Wallis Test was also carried out to compare group 1a, group 1b and group 2 with respect to accuracy and reaction time.
- ✓ Wilcoxon Signed Ranks Test was carried out for within group comparison with respect to accuracy and reaction time.

Chapter IV

RESULTS AND DISCUSSION

The main aim of the present study is to find out the processing of noun and verb in Malayalam-English bilingual individuals with anterior and posterior aphasia and to compare the similarities and differences between the individuals with bilingual aphasia and normal individuals for the processing of nouns and verbs. The study also aimed to check for the language difference in the processing of nouns and verbs. Four sets of stimuli were presented to each subject and both accuracy and reaction time were calculated. The reaction time so obtained was tabulated and analyzed. Data was obtained from three groups of subjects.

Group 1a: Individuals with anterior aphasia

Group 1p: Individuals with posterior aphasia

Group 2: Normal individuals

The statistical analysis was carried out in two steps.

Step 1: Includes the analysis of accuracy measurement.

Step 2: Includes the analysis of reaction time measurement.

Accuracy measurement

Accuracy refers to the number of correct responses obtained from each subject. The accuracy measurement obtained for group 1a (Individuals with anterior aphasia), group 1p (Individuals with posterior aphasia) and group 2 (normal individuals) were tabulated and analyzes.

Table 4.1: The number of correct responses obtained from group 1a

Subject	Number of correct responses obtained from each subject			
	Noun		Verb	
	English	Malayalam	English	Malayalam
1	3/10	6/10	0/10	1/10
2	1/10	8/10	1/10	4/10
3	1/10	9/10	0/10	4/10
4	4/10	6/10	0/10	0/10
5	4/10	7/10	0/10	3/10
Total	13/50	36/50	1/50	12/50

Table 4.2: The number of correct responses obtained from group 1p

Subject	Number of correct responses obtained from each subject			
	Noun		Verb	
	English	Malayalam	English	Malayalam
1	4/10	2/10	0/10	5/10
2	1/10	4/10	0/10	2/10
3	2/10	0/10	3/10	3/10
4	0/10	2/10	4/10	7/10
5	9/10	1/10	1/10	7/10
Total	16/50	9/50	8/50	24/50

Table 4.3: The number of correct responses obtained from group 2

Subject	Number of correct responses obtained from each subject			
	Nouns		Verbs	
	English	Malayalam	English	Malayalam
1	6/10	8/10	9/10	9/10
2	8/10	9/10	10/10	10/10
3	10/10	10/10	8/10	10/10
4	10/10	9/10	9/10	10/10
5	10/10	9/10	10/10	10/10
6	9/10	9/10	9/10	9/10
7	10/10	10/10	9/10	10/10
8	10/10	10/10	10/10	10/10
9	10/10	9/10	10/10	9/10
10	8/10	10/10	5/10	9/10
Total	91/100	93/100	89/100	96/100

Table 4.4: The mean and standard deviation of group 1a, group 1p and group 2

Group		Nouns		Verbs	
		English	Malayalam	English	Malayalam
Anterior	N	5	5		5
	Mean	2.6	7.2		2.4
	Std. Deviation	1.5	1.3		1.8
Posterior	N	5	5	5	5
	Mean	3.2	1.8	1.6	4.8
	Std. Deviation	3.6	1.5	1.8	2.3
Normals	N	10	10	10	10
	Mean	9.1	9.3	8.9	9.6
	Std. Deviation	1.4	0.7	1.5	0.5
Total	N	20	20	20	20
	Mean	6.0	6.9	4.9	6.6
	Std. Deviation	3.8	3.3	4.4	3.5

Table 4.4 depicts the mean and standard deviations of performance of the three groups across noun and verb retrieval tasks. The results show that performance of normal individuals was better than individuals with aphasia. Among individuals with aphasia, individuals with anterior lesion performed poorer in verb retrieval task than individuals with posterior aphasia.

Table 4.5: The mean and standard deviation of individuals with aphasia and normals

Group		Nouns		Verbs	
		English	Malayalam	English	Malayalam
Aphasics	N	10	10	10	10
	Mean	2.9	4.5	0.9	3.6
	Std. Deviation	2.6	3.1	1.4	2.3
Normals	N	10	10	10	10
	Mean	9.1	9.3	8.9	9.6
	Std. Deviation	1.4	0.7	1.5	0.5
Total	N	20	20	20	20
	Mean	6.0	6.9	4.9	6.6
	Std. Deviation	3.8	3.3	4.4	3.5

Table 4.5 gives the mean and standard deviation of performance of individuals with aphasia and normals in the noun and verb retrieval task. From the table, we can

interpret that the performance of normal individuals was better than indivuals with aphasia.

Mann-Whitney Test was carried out for between group comparisons.

1) To compare group 1 and group 2.
2) To compare group 1a and group 1p.
3) To compare group 1a and group 2.
4) To compare group 1p and group 2.

English verb in individuals with posterior aphasia and normals were compared separately using Mann-Whitney test as there was only 3 patients responded to the task and others were no responses. Individuals with anterior aphasia were not considered for English verb comparison because only one subject responded to the task and others were no responses. It could not be compared statistically as there was not sufficient number of responses.

Comparison of group 1 and group 2 (Individuals with aphasia and normals) was carried out using Mann-Whitney test. Results showed that there was significant difference between the three groups at $p<0.05$ level of significance in all the categories. That means individuals with anterior aphasia, posterior aphasia and normals showed significant difference in their performance for noun and verb retrieval task. Comparison of group 1a and group 1p was carried out using Mann-Whitney test and the results reveal that significant difference was seen in Malayalam noun category at $p<0.05$ level of significance between the two groups. English Verb category was not considered because of the limited number of responses obtained from the patients. Mann-Whitney test was also carried out for the comparison of group 1a and group 2 and group 1p and group2. Results revealed that there was

significant difference at $p<0.05$ level of significance between all the groups in all categories except English verbs.

Comparison of group 1p and group 2 in English verb category was carried out separately using Mann-Whitney test and found that there was significant difference at $p<0.05$ level of significance between the two groups in English verb category.

Kruskal-Wallis Test was also carried out for between group comparison of group 1a, group 1p and group 2. Results reveal that there was significant difference between the three groups in all the categories at $p<0.05$ level of significance.

Wilcoxon Signed Ranks Test was carried out for within group comparison.

1) Comparison within individuals with anterior aphasia.
2) Comparison within individuals with posterior aphasia
3) Comparison within normal individuals.

Comparison within individuals with anterior aphasia (Group 1a) revealed that there was significant difference at $p<0.05$ level of significance between the compared categories in individuals with anterior aphasia. Comparison within individuals with posterior aphasia (Group 1p) revealed that there was no significant difference observed at $p<0.05$ level of significance in the compared categories within individuals with posterior aphasia. Comparison within normal individuals (Group 2) revealed that there was no significant difference observed at $p<0.05$ level of significance in the compared categories within normal individuals.

The following figures represent the comparison between the three groups of each category,

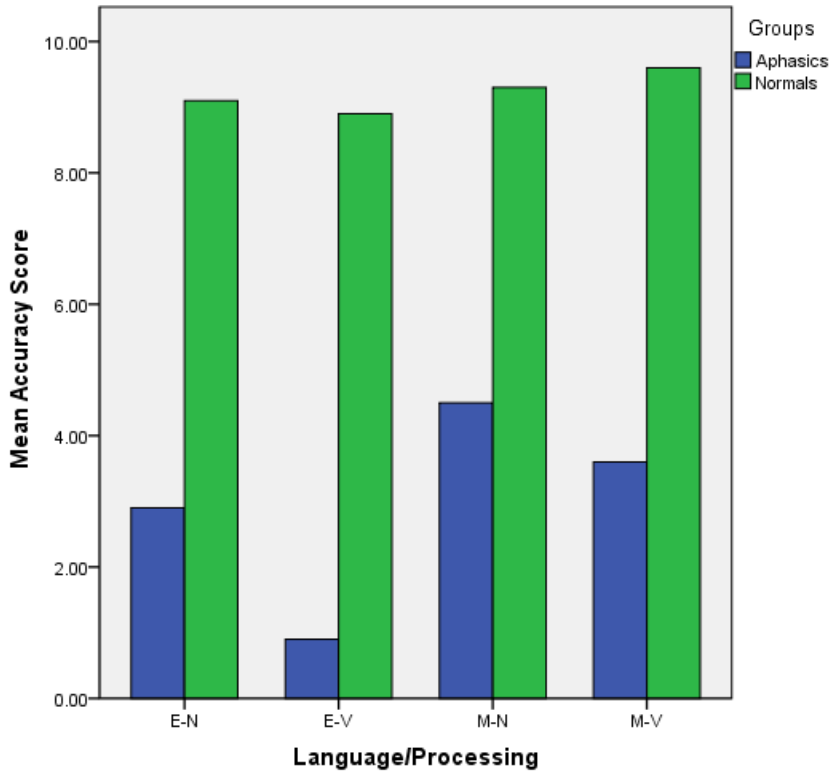

Figure 4.1: The comparison of individuals with aphasia and normal individuals

From figure 4.1 it is clear that accuracy is more in normal individuals than in individuals with aphasia in all the categories.

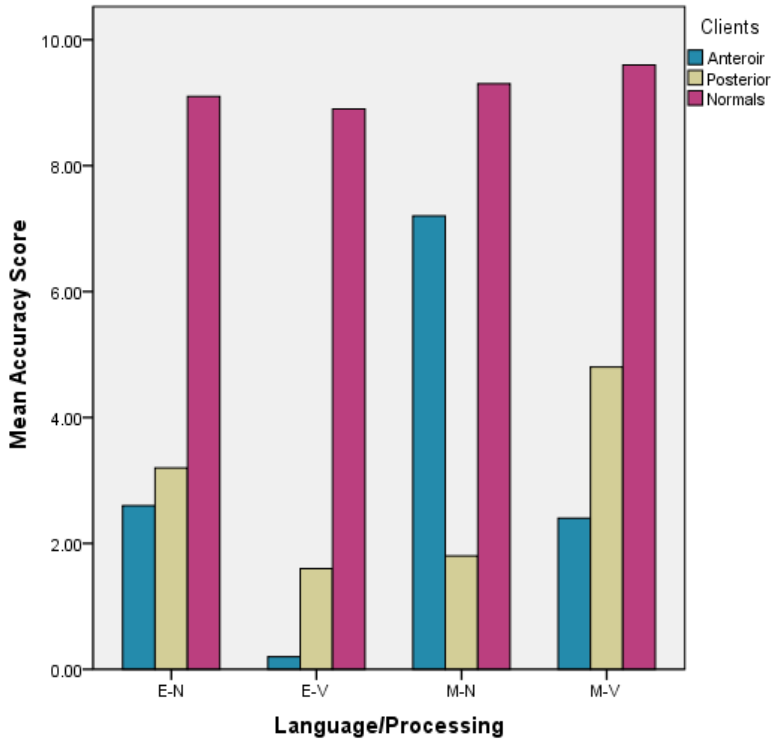

Figure 4.2: The comparison of group 1a, group 1p and group 2

From figure 4.2 we can interpret that accuracy is more in normal individuals in all the categories. In the case of anterior aphasia accuracy is more in Malayalam noun category and in posterior aphasia accuracy is more in Malayalam verb category.

From the above tables and graphs we can interpret that noun deficits are more common in individuals with posterior aphasia compared to individuals with anterior aphasia and normal individuals. Similarly, individuals with anterior aphasia showed verb retrieving problems compared to individuals with posterior aphasia and normal individuals. Most of the subjects showed better retrieval in their native language (L1) than the second language (L2). One interesting finding is that all the subjects performed better in noun retrieval than verb retrieval in their second language that is, English. Vigliocco et al. (2006) reported that verbs are morphologically more complex than nouns in most languages. The present study is in consonance with

Vigliocco's findings. But in their native language, most of the subjects exhibited almost equal proficiency in both noun and verb retrieval. This may be because of the frequency of use of those words in their native language.

Several neuroimaging studies have been reported to find out the disproportionate impairments of nouns and verbs in Western context with limited studies of bilingual individuals. But there were no Indian studies that have been reported till now. So, the present study has some significant importance to this area. Recent functional neuroimaging studies (PET and IMRI) investigating the neural representation of nouns and verbs have been interpreted as supporting the claim for regional specialization, with the left inferior prefrontal cortex being specialized for verbs and left temporal cortex specialized for nouns (Petersen et al., 1988; Perani *et al.*, 1999). The present study is also supporting this claim as it was found that those patients who had lesions in the left frontal region showed verb retrieval deficits and patients who had lesions in the left temporal region showed noun retrieval deficits. The present study makes use of accuracy and reaction time paradigm to find out the processing of these two grammatical categories rather than neuro imaging techniques. No reaction time and accuracy measurement studies are available in this area and this is cost effective than neuroimaging techniques. So this study highlights the future research scope.

Noun and verb comprehension and production were investigated in two groups of late bilingual, Greek-English speakers by Kambanaros and Steenbrugge (2005). They found that there were no significant differences in verb or noun comprehension between the two groups in either language. But the present study is in contrast with their study and found better noun and verb retrieval in their native language than their second language. That is, they were proficient in their native language (L1). This may

be because the patients might have recovered their native language first after the CVA, the environmental factors, greater number of exposure to native language and also the frequency of use of their native language.

Reaction time measurement

Reaction time refers to the interval of time between the application of a stimulus and the first indication of a response. The reaction time analysis was done by averaging each subject's responses in all categories (Malayalam noun, Malayalam verb, English noun & English verb).

Table 4.6: The mean and standard deviation of group 1a, group 1p and group 2

Group		Nouns		Verbs	
		English	Malayalam	English	Malayalam
Anterior	N	5	5	1	4
	Mean	316.4	265.4	351.8	441.1
	Std. Deviation	147.7	104.9		209.5
Posterior	N	4	4	3	5
	Mean	360.1	376.3	230.1	332.5
	Std. Deviation	251.8	248.4	50.3	367.6
Normals	N	10	10	10	10
	Mean	172.3	127.9	207.4	130.4
	Std. Deviation	129.8	56.7	93.9	49.3

Table 4.7: The mean and standard deviation of individuals with aphasia and normals

Group		Nouns		Verbs	
		English	Malayalam	English	Malayalam
Aphasics	N	9	4	9	9
	Mean	335.8	260.9	314.7	380.8
	Std. Deviation	187.6	73.3	179.1	295.5
Normals	N	10	10	10	10
	Mean	127.2	207.4	127.9	130.4
	Std. Deviation	129.8	93.9	56.7	49.3

The mean reaction time and standard deviation of individuals with posterior aphasiarevealed that they exhibited longer reaction time for noun retrieval than verb retrieval. But individuals with anterior aphasia exhibited the opposite profile. But in reaction time paradigm none of the subjects exhibited any language priority. Individuals with anterior aphasia took longer reaction time in English noun category than in Malayalam noun category. But they took longer reaction time in Malayalam verb category than in English verb category. Individuals with posterior aphasia showed longer reaction time in Malayalam noun and Malayalam verb category than English noun and English verb category. But normal individuals exhibited longer reaction time in their second language. This result may not be considered as significant in language priority because of the higher standard deviation.

Mann-Whitney Test was carried out for between group comparisons.

1) To compare group 1 and group 2.
2) To compare group 1a and group 1p.
3) To compare group 1a and group 2.
4) To compare group 1p and group 2.

English verb in individuals with posterior aphasia and normals were compared separately using Mann-Whitney test as there were only 3 patients who responded to the task and others gave no responses. Individuals with anterior aphasia were not considered for English verb comparison because only one subject responded to the task.

Comparison of group 1 and group 2 (Individuals with aphasia and normals) using Mann-Whitney test revealed that there was significant difference at $p<0.05$ level of significsnce in Malayalam noun category across 3 groups. No significant difference was seen in other categories because of the higher standard deviation. Comparison of group 1a and group 1p revealed that there was no significant difference observed at $p<0.05$ level of significance in the compared categories between groups because of the higher standard deviation. English verb category was not considered because of the limited number of responses. Comparison of group 1a and group 2 revealed that there was significant difference at $p<0.05$ level of significance in Malayalam noun and Malayalam verb categories between groups. Comparison of group 1p and group 2 revealed that there was significant difference at $p<0.05$ level of significance in Malayalam noun category between the two groups.

Comparison of group 1p and group 2 in English verb category using Mann-Whitney test revealed that there was significant difference at $p<0.05$ level of significance between the groups in English verb category.

Kruskal-Wallis Test was also carried out for between group comparisons. Comparison of group 1a, group 1p and group 2 revealed that only Malayalam noun category exhibited significant difference at $p<0.05$ level of significance across three groups.

Wilcoxon Signed Ranks Test was carried out for within group comparison.

1) Comparison within individuals with anterior aphasia (Group 1a).
2) Comparison within individuals with posterior aphasia (Group 1p).
3) Comparison within normal individuals (Group 2).

Comparison within anterior aphasia revealed that there was no significant difference observed at $p<0.05$ level of significance in the compared categories within the group. Comparison within posterior aphasia revealed that there was no significant difference observed at $p<0.05$ level of significance in the compared categories within the group. Comparison within normal group revealed that there was no significant difference at $p<0.05$ level of significance observed in the compared categories within the group.

The following figures represent the comparison between the three groups of each category in reaction time paradigm,

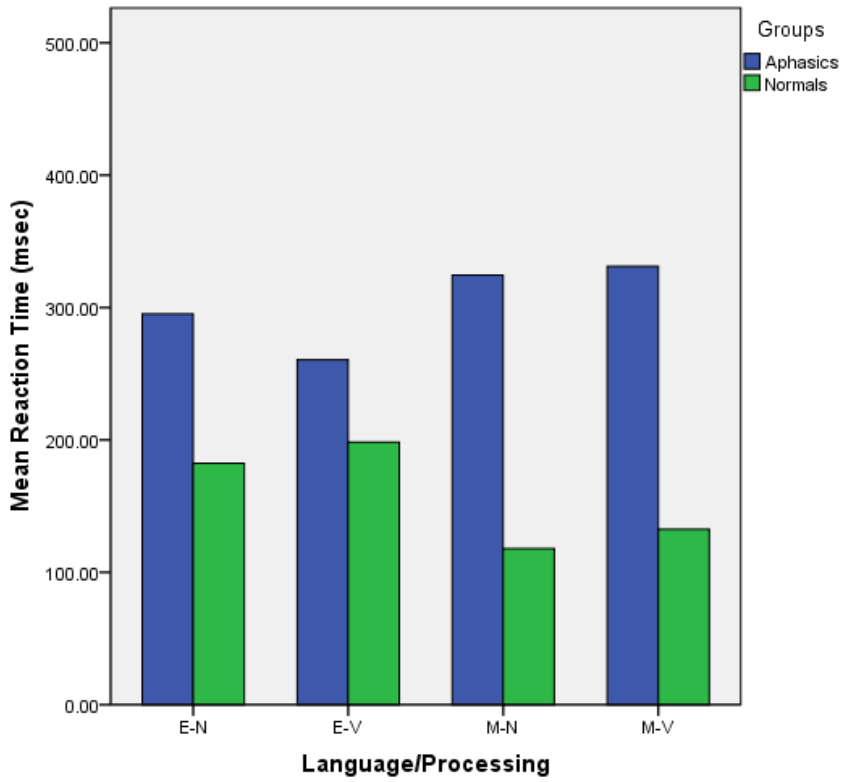

Figure 4.3: The comparison of individuals with aphasia and normal individuals

From figure 4.3 it is evident that individuals with aphasia exhibited longer reaction time than normal individuals.

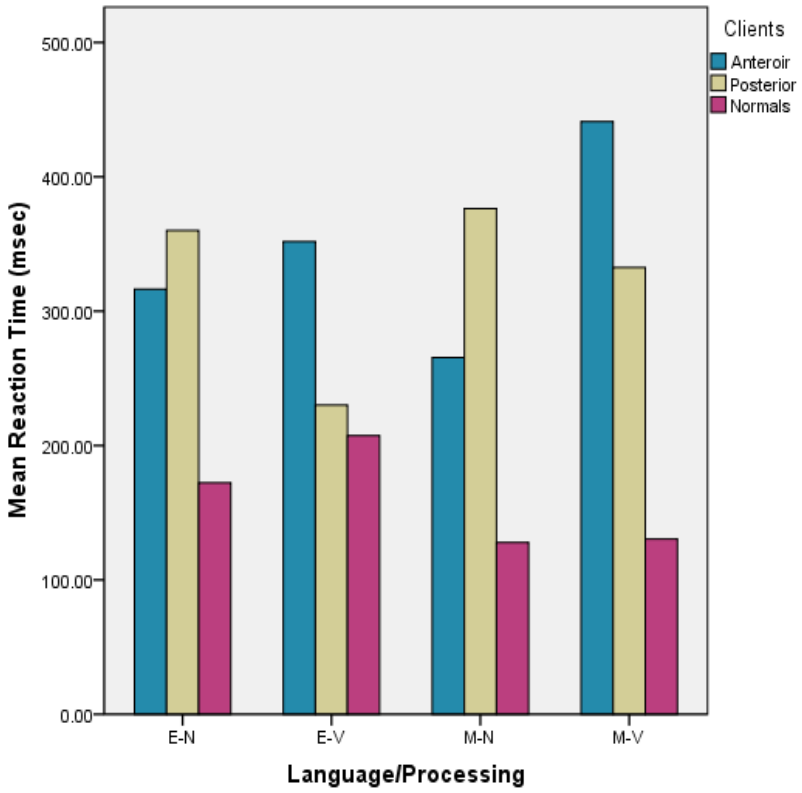

Figure 4.4: The comparison of group 1a, group 1p and group 2

Figure 4.4 shows that individuals with anterior aphasia exhibited longer reaction time in Malayalam verb and English verb category and individuals with posterior aphasia exhibited longer reaction time in English noun and Malayalam noun category. Normal individuals exhibited less reaction time in all the categories compared to individuals with anterior and posterior aphasia.

The classic double dissociation suggests that there are relatively separate lexical-mediation systems for concrete nouns and verbs. The systems that appear essential for retrieving proper nouns and certain classes of common nouns are in left anterior and middle temporal cortices. (Other common nouns can be retrieved from systems in left posterior temporal and occipitoparietal cortices and damage to those systems do not compromise on verb retrieval. The rationale for this hypothesis comes from the observation that damage to left frontal cortices impairs the retrieval of verbs

more markedly than the retrieval of nouns. (Damasio, 1992). Miceli, Silveri, Caramazza and Hillis (1984,1991) reported that verb retrieval was more defective than noun retrieval in individuals with aphasia with presumed left frontoparietal damage. The present findings are also supporting the claim of double dissociation. Individuals who presents with lesion in the left frontal lobe exhibited longer reaction time for verb retrieval and the accuracy was also less. Their performance in noun retrieval task was better compared to verb. But they didn't exhibit any language priority because of the highest standard deviation. But in accuracy measurement they showed better retrieval in their native language. Individuals with posterior aphasia, who presented with lesion in the left temporal lobe, exhibited longer reaction time for noun retrieval task than verb retrieval and accuracy was also less compared to noun retrieval. Most of the subjects showed better performance in their native language.

To conclude, the present study adds the body of evidence that supports the double dissociation of nouns and verbs in separate neural centers. Accuracy measurements state that most of the subjects performed better in their native language than their second language. This finding is contradicting with Kambanaros and Steenbrugge (2005). They did not find any significant difference in verb or noun comprehension between the Greek-English bilingual individuals. The present study has an exploratory value and prompts to the future research as no Indian study has been reported in individuals with bilingual aphasia using reaction time paradigm.

Chapter V

SUMMARY AND CONCLUSION

The present study is an attempt to explore the processing of nouns and verbs through reaction time paradigm in bilingual Malayalam-English individuals with anterior and posterior aphasia. Evidences from several neuroimaging studies revealed that disproportionate impairment for nouns tends to correlate with damage to more posterior areas (temporal areas), while a disproportionate impairment for verbs tends to originate more often from damage to frontal areas of the left hemisphere. Bilingual aphasia provides an important avenue to investigate whether any dissociation between the processing of nouns and verbs is confined to only one of the bilingual individual's language or not, in other words, whether any differences in noun and verb processing could be language specific not. Four sets of stimuli were used for the study and the reaction time and accuracy were measured. The obtained accuracy and reaction time were tabulated and analysed.

Results of the present study are in consonance with the studies of noun and verb dissociation. Reaction time and accuracy measurements revealed that, individuals with anterior aphasia exhibited longer reaction time in verb retrieval and accuracy was also less compared to nouns. Opposite profile was seen in individuals with posterior aphasia. They showed longer reaction time and less accuracy in noun retrieval. Most of the subjects showed better performance in their native language that is, Malayalam than in the second language that is, English.

Inferences that can be drawn from the present study:

1) The present study is supporting the claim of noun and verb dissociation in separate neural centers.

2) Noun retrieval is better in individuals with anterior aphasia and verb retrieval is better in individuals with posterior aphasia.
3) All the subjects performed better in noun retrieval than verb retrieval in their second language that is, English and they exhibited almost equal proficiency in both noun and verb retrieval in their native language.

The present study employed accuracy and reaction time paradigm to find out the processing of two grammatical categories nouns and verbs rather than neuroimaging techniques. No reaction time and accuracy measurement studies are available in this area and this is cost effective than neuroimaging techniques. This study highlights the scope of future research in the area. The information obtained from such studies help the speech language pathologist to plan management based on the type of aphasia.

To conclude, the present study adds the body of evidence that supports the double dissociation of nouns and verbs in separate neural centers. Accuracy measurements states that most of the subjects are performed better in their native language than their second language. The present study has an exploratory value and prompts further future research because no Indian study has been reported in individuals with bilingual aphasia using reaction time paradigm so far.

Implications of the study:

- The results of the study will help to provide a better insight into the nature of noun and verb processing in bilingual individuals with anterior and posterior aphasia.
- The data drawn from such studies can be used to evaluate or screen and can be used for the management of bilingual individuals with aphasia.

- Compared to neuroimaging techniques, reaction time measurement techniques are less expensive. So they can be used for research purposes in the field of speech language pathology.
- As there are no Indian studies in this area, this study can be used as a stepping stone for future research.

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