PRIME TYPE AND LEXICAL RETRIEVAL IN NORMAL HEALTHY ELDERLY BILINGUAL ADULTS

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CERTIFICATE

This is to certify that this dissertation entitled **"Prime Type and Lexical Retrieval in Normal Healthy Elderly Bilingual Adults"** is the bonafide work in part fulfilment of the degree of Master of Science (Speech-Language Pathology) of the student (Registration No. 13SLP025). This study 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 Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **"Prime Type and Lexical Retrieval in Normal Healthy Bilingual Adults"** is the result of my own study under the guidance of Dr. K.S. Prema, Professor of Language Pathology, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier to any other University for the award of Diploma or Degree.

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CHAPTER I

INTRODUCTION

Language is a set of codes and arbitrary symbols and human beings are more versatile in using language as a means of communication. Human beings use language to express their thoughts, ideas and emotions. Researchers have studied representation of language and its processing in different populations such as in monolinguals, bilinguals and multilingual and also in aging population, persons with aphasia, and dementias. Among these, language representation and its processing in bilinguals have been carried out extensively in the recent past with interesting findings. Language representation refers to the organization of mental lexicon in the brain and language processing refers to the mechanism for understanding and retrieval of lexicon that is very well applicable to even bilinguals who process two languages.

Bilinguals differ in several aspects in terms of acquisition of language (sequential or simultaneous), interaction within and between the languages and also how the mental lexicon has been represented conceptually with respect to the languages (shared or separate). The mental lexicon is highly interdependent in nature in which the words share the phonological, orthographical, morphological and semantic features. During the actual presentation of the word, the lexical features also get activated. In bilinguals these features get activated in one or both of the languages during the processing of word as lexical recognition. This may result either as facilitating or interfering effect depending on activation of one or both the languages and features. Weinrich (1953)

proposed three types of bilingualism. It includes Coordinate, Compound and Subordinate types. The type of bilingualism is determined by the age of acquisition of languages(s) as well as the shared versus separate storage mechanism of memory systems for L1 and L2. To examine the lexical processing in different types of bilinguals, various methods have been used. In the recent past, many methodologies and paradigms have been used to study the bilingual lexicon and lexical access. Among several paradigms, priming paradigm has gained greater importance and both the automatic or implicit processing, conscious or explicit processing has shown facilitatory effect depending on the duration of the prime.

Several models have been put forth by different investigators with different perspectives to explain the mental lexicon. Among them, the Spreading activation model has retained the idea of network construction of mental lexicon. It is highly effective in explaining the underlying semantic processing mechanisms during the retrieval of a word. According to this model, the words are represented in terms of nodes and these nodes are widely linked to each other. Depending on the nature of signal (excitatory or inhibitory), words are activated or suppressed. The words get activated when it reaches the threshold and the word which is retrieved faster depends on the greatest level of activation. Semantic, phonological and associative information can be carried through the links which are connected to the nodes.

With respect to automatic activation spreading model, the target gets activated by a prime within a semantic network thus, highlighting the link

between the prime and target nodes (Collins and Loftus, 1975). According to this model, semantic priming occurs because of the prime stimulus which creates a learning episode which in turn results in varying the linking weights within the units which process the characterization in word knowledge (Becker, Moscovitch, Behrmann & Joordens, 1997; Joordens & Becker, 1997) changes in the state of activation during semantic processing in spreading activation mode. Whittlesea and Price (2001) conducted an experiment similar to masked priming experiments and the pictures of the objects were presented as stimulus pairs in a rapid visual sequence (masked items were presented in series than as single prime item) with an exposure of stimulus for 40ms and with no inter stimulus interval and subjects were asked to recognize the old versus new item. They found that subjects performed better in differentiating the new stimuli from stimulus being exposed previously in the judgment task. They attributed that stimuli with brief presentation for multiple times with masked exposure can have a long lasting effects on behavior. It has been reported that long lasting effects were predicted even when there were slight changes in connection weights in automatic activation spreading model unlike temporary. These findings were based on the investigations carried out using different types of priming tasks across languages in bilinguals. Since the present study is proposed to examine semantic retrieval mechanism in healthy aging individuals, the following section gives detailed review on aging population.

1.1 Representation and Processing of Language in healthy aging adults

Aging is a process across the adult life span. The changes at cellular, organ and whole-body level takes place during the process of aging. The process involved is multidimensional which includes change in physical, psychological, and social. There are few aspects such as knowledge of world events which grow and expand as age increases and others may decrease as aging throughout the life span for example, reaction time.

Language in an elderly has been studied widely with greater interest (Craik & Masani, 1967; Riegel & Riegel, 1964). Decline in language across lifespan was noticed and the area of research focused more on comparing the representation and processing of language among old age population and adults of younger age. The aging pattern was observed to be different in terms of cognitive and linguistic aspects. Studies have shown that some aspects of both cognitive and language were retained and stabilized and others get deteriorated. Studies have been carried on language attrition covering different population which include aphasia, healthy aging, dementia and bilingual and multilingual speakers. Language attrition in bilingual population has been studied to a large extent and further it was put forth in different views by linguists, sociolinguists, neurolinguists and psycholinguists by applying their own strategies to account for language loss. They found that some components of language are more prone to deteriorate than others. Attrition of first language in bilinguals has been attributed to the age of acquisition and to understand the mechanisms underlying the normal processing which occurs throughout the life (Berko-Gleason, 1982;

De Bot & Weltens, 1991). Studies on normal elderly has shown decline in precise areas and based on tasks which were employed to detect those can also be used to prove bilingual language attrition.

Various theories and models of language have been proposed and used as a framework in cognitive aging to explain for the age related deficits, such as slowness in general, inhibition, transmission, working memory, and sensory deficits. These deficits can be called as resource deficits and some of the theories overlap while explaining the deficits underlying the aging. Research carried out on healthy aging population has revealed that retrieval of a word during the word production task and comprehension of complex material are the two main aspects which were found to be difficult in older individuals. Studies focused on word production and lexical retrieval ability, have used picture naming tasks and have analysed the tip of the tongue phenomenon. Studies on language loss in bilinguals employed grammatical judgement tasks to measure the language competence and performance. Studies on bilinguals have found that language attrition can be seen either in L1 (first language) or in L2 (second language) depending on the acquisition of language and how long the individual is exposed to each of the languages. Language suppression in the context of bilinguals has also been proposed and these are mainly employed by using switching tasks.

1.2 Relationship between aging and lexical retrieval

Studies have reported difficulty in elderly adults for retrieving the target word (lexical retrieval deficits) can be attributed to the simultaneous activation

of information not directly related to target word. This effect can be explained on the basis of, inability to suppress the inhibition of irrelevant information which gets activated along with the target which in turn results in reduction of the response competition in older individuals. These breakdowns could be attributed to word retrieval difficulties in older population (Blaxton & Neely, 1983; Smith & Tindell, 1997). Studies on single word processing task in normal healthy adults have shown efficient memory store for words and also links semantically between the lexicons but the retrieval of word from the memory slows down. In addition to that it becomes difficult especially for single words. Hence, healthy older adults get advantage of when asked to retrieve single words for a specific context reasonably than words per se that are without any contextual clues. Various experimental paradigms have been employed, some of which include implicit and explicit, non-speeded tasks to study the lexical retrieval processing and the best employed and widely used paradigm is semantic priming.

1.3 Priming

Priming refers to the target representational unit by the pre-threshold excitation, the process that in turn triggers retrieval (MacKay, 1987). Priming involves implicit processing which is a non-conscious form of human memory in which experience to one stimulus influence the reaction to a new stimulus. At the cortical level representation, the prime and the target are interconnected to each other in some way and hence the activation of the prime in turn activates

the target representation units automatically. Presentation of stimulus in priming experiment involves successive presentation of two words wherein the first word being the prime and the second represents the target to which response has to be made**.** The time duration between the onsets of the prime till the initiation of the target is called as Stimulus Onset Asynchrony (SOA) (Harley, 2005). Priming can have two effects on word recognition, either facilitation of the target thereby the reaction time taken will be less or it can have interference with the target which results in more reaction time thereby longer time to respond.

1.3.1Types of Priming

Several types of priming have been employed to understand the underlying mechanisms in linguistic processing.

a. Cross linguistic priming

According to this type of priming, the effect of prime is examined across two or more languages and the presentation of prime and target differs in terms of languages and their effects on each other for language processing are measured. E.g. 'bekku' (cat in L1) – 'dog' (target) in L2.

b. Semantic priming

Semantic priming refers to occurrence of priming when the prime belongs to the same category that of target which in turn does share few common structures. For example, the word 'dog' is priming semantically for 'wolf', because it shares few common features such as in terms of looks. This type of priming is speculated to work out

for the reason that spreading activation between the neural links. During the production of a word, individual thinks of specific thing in a grouping, and the adjacent or connected items which are similar are further activated by the brain. Although if they are not words, morphemes can also prime for complete words that include them. For an example, the morpheme 'enter' can prime for the word 'entertainment'.

c. Translation Priming

In translation priming, the presentation of the prime word and target is differed by language. Either the language can be used as a prime (L1 or L2) and followed by the target in other language (L2 or L1) of a bilingual. E.g. ‘bekku’ (prime in L1, Kannada language) is followed by the presentation of ‘cat’ (target in L2, English language). In translation priming, automatic activation to its lexical entry by the prime results in shorter SOA’s in bilinguals, however depending on several factors such as proximity of language structure, proficiency and usage among others. (Foster & Davis, 1984).

d. Phonological Priming

Here, the prime and target stimulus are related to each other phonologically, for example, ‘cup’ (prime) followed by target ‘cat’ (target).

e. Syntactic priming

Here, the prime and the target are syntactically related to each other. E.g. ‘cat’ (prime) followed by target ‘a cat that’s on a table’.

f. Orthographic Priming

This type of priming specifically influences visual word recognition as it involves use of orthography. Here, a visual prime is spelled similar to target word. Usually the prime and target words share all the same letters except for one. Example,‘farn’ (prime) followed by target ‘barn’.

The above types of priming tasks can be employed using masked priming paradigms as detailed below.

1.4 Masked priming

This concept was first developed by Forster and Davis (1984), where it involves variation in the presentation of the stimuli. This type if priming is also called as sandwich technique where in the prime is sandwiched between the hash marks (####) and the target stimulus. The presentation of the masked priming includes a SOA of short duration, with no overriding items between prime stimulus and target stimulus. The duration of the prime is also kept less where the subjects are highly unaware of the nature of the prime being presented. Two types of masking can be given during the presentation, one is called the forward type of masking, and the second is called as the backward masking. In the forward mask, hash marks in a row wise is (####) presented for a duration of 500ms prior to the presentation of the prime with a duration of 50ms. This can

be either orthographic or semantic type and presented in lower case followed by the target stimulus presented for duration of 500ms in upper case format. The row of hash marks can be in accordance with the width of the prime to cover it completely (for example, for SWEET- #####).

Example:

Table 1
Example for masked priming stimulus

Masking (500 ms)	###
prime (50 ms)	Cat
target (500 ms)	CAT

The difference in the presentation of the hash marks before the prime or after the presentation of the prime gives rise to forward masking or backward masking. The main advantage of using masked priming experiments with a grouping of both forward and backward mask of primes and the exposure to very short duration results in tapping the implicit processing mechanism where in the subject is prevented from being aware of a prime's identity and often subjects may be unaware of the occurrence of prime event.

1.4.1Variables

There are number of variables which can have a significant impact on priming phenomenon and hence those variables should be kept under control. The variables are:

1) Prime and target relationships in terms of syntactic or semantic relationship to one another.

2) Presentation order of the stimuli, which can be either forward or backward masking in nature.
3) Formatting the presentation of prime and the target stimulus i.e., either using orthographic or picture as a stimuli and if both are presented in same format or in cross format.
4) The prime can be presented either in the auditory or visual mode.
5) Temporal aspects include prime duration, and stimulus onset asynchrony.

1.4.2 Advantage of using masked priming as a paradigm

Masked priming involves tapping the implicit processing mechanism or the automatic processing mechanism which is devoid of any involvement of strategic processing or the processes which occurs through the conscious awareness as in explicit processing. The conscious awareness of the prime can be altered to non-conscious way of processing by using masked primes Breitmeyer, 2007), which do not render the use of strategies (Henson, 2003; Merikle, Joordens, & Stolz, 1995), and also typical priming effects can be retained. Masked priming has smaller magnitude compared to unmasked (Kiefer, 2002; Kiefer & Spitzer, 2000), and these subliminal masked priming effects reflect in semantic word meaning that are accessed implicitly (Adams & Kiefer, 2012; Kiefer & Martens, 2010; Kiefer & Brendel, 2006; Marcel, 1983).

1.5Need for the study

The lexico-semantic network for word retrieval in aging population is not clear. Studies have shown that the use of masked priming in aphasics facilitates

the automatic spread of activation, and that the strength and time of the spread of activation can be assessed in addition to the degree of automatic spread of activation. However, there is a dearth of research on normal healthy aging bilingual adults with respect to the retrieval of lexicon. There are no studies which have focused on masked repetition and translation priming on healthy aging adults in Indian scenario and this study would be first attempt to study on those aspects. Western studies have shown that masked priming paradigm taps implicit processing and therefore, study of normal healthy aging individuals by employing masked priming paradigms could provide some important insights into implicit processing of lexicon in bilinguals.

1.6 Objectives

The main objective of the present study is to investigate implicit lexical retrieval mechanism across age in normal healthy aging bilingual adults.

In the present study, masked priming paradigm has been used in two different conditions, one being the masked translation priming and other one being the masked repetition priming condition to understand the bilingual processing mechanism in healthy elderly adults.

CHAPTER II

REVIEW OF LITERATURE

In the last few decades, the issue related to bilinguals and how well the two languages are represented cognitively, processed and produced has been investigated with greater interest. Earlier research during 1960's and 1970's revealed two different opinions in studies related to organization of mental lexicon in bilinguals as one versus two separate concept stores. While a few researchers support the shared concept store others emphasize on separate concept store (Kolers, 1963). However, the difference in opinions also holds well in various other populations including multilingual speakers, healthy elderly individuals and brain damaged individuals. In order to comprehend the processing mechanism in healthy older adults, an extensive literature has been reviewed starting from the definitions of bilingualism to how the language deteriorates in healthy older adults.

2.1 Definitions of Bilingualism

Bilingualism refers to the use of two or more languages alternatively by the same individual. Bilingualism is defined as native like control in two languages (Bloomfield, 1933). Haugen, (1953) states that bilingualism begins 'at the point where a speaker of language can produce complete, meaningful utterances in other language.' According to ASHA (2004) bilingualism has been defined as the use of at least two languages by an individual. A bilingual can be on a continuum depending on the situation s (h) e is in. The same person may be

either on a monolingual or bilingual mode and he may be mixing languages freely (Grosjean 1982). Of the various definitions, Grosjean (1989) considered the holistic view and he further considered bilingual speakers as those individuals who speak in two or more languages in a daily life and this definition was more realistically based. Perfect knowledge of both languages is not required; instead, people use different languages for different purposes or life domains and consequently have different levels of proficiency within their languages across those domains.

According to Thirumalai and Chengappa (1985) bilingualism has been described as

a) Bilingualism is considered as the property of an individual when the language is considered as a property of group.

b) They presuppose the existence of two different language communities when individual is able to use two languages in his community. It explains that there is an existence of bilingual community.

c) They describe bilingualism as characteristic of its use and not as a phenomenon.

d) Bilingualism is viewed as interaction between culture and social groups. According to this view, bilingualism is defined as an ability of an individual to express himself/herself in a second language by using

the appropriate structure of that language in all aspects instead of paraphrasing something expressed in his language.

e) Bilingualism is considered as something relative because at which point of time individual uses second language is not possible to determine.

Bilingualism can be classified as (a) simultaneous bilingualism and (b) sequential bilingualism (ASHA, 2004).Each bilingual is considered as a unique depending on the experience and exposure to language he or she has while interacting with others.

Simultaneous Bilingualism: It refers to young children being exposed to two languages simultaneously and meaningfully from birth.

Sequential Bilingualism: It refers to the condition in which the child has acquired the first language well and then after the age of 3 child being exposed to second language with sufficient amount and meaningfully.

Weinrich (1953) proposed three types of bilingualism. It includes Coordinate, Compound and Subordinate types.

Coordinate bilingual: In this type of structure, the bilingual operates separate form and meaning units (two separate mental lexicon) depending on the language. Here both the form and meaning is language specific. This condition occurs when an individual is exposed to two different languages and in separate

environments. For example, as the child joins to school, second language (l2) will be exposed.

Compound bilingual: The bilingual operates two different forms depending on the language and merged meaning units. Here the form is language specific and meaning is shared (conceptual centre remain the same for both L1 and L2).This condition occurs when an individual exposed to two different languages in the same context and which results in fused representation of the languages in the brain.

Subordinate bilingual: In this type of structure, the bilingual possess two separate forms depending on the language and here the form of weaker language will be attached to the form representation of the stronger one or the dominant language (L1) with a shared representation of meaning that of his native language. This type of condition is evident when the second language of a child is acquired after the well establishment of first language, and so remains dependent upon it.

Several studies have been carried out on bilingualism and how they represent the language in brain and still the question remains whether the bilinguals have shared or independent mental lexicon for each of the language separately? Whether bilinguals process the information by shared mental dictionaries or independent mental dictionaries depending on the language? Also questions like whether bilinguals have integrated conceptual and lexical memory or two of them separately represented in bilingual brains?

2.1.2Language representation and Language processing in Bilinguals

Language representation in bilinguals refers to how well the two languages are structured and organized in bilinguals cognitively. At the processing level it represents how the words are stored at different levels and how they are processed. Higher representation levels include mapping of lexical to semantic or the conceptual structure, lower level of representation include mapping the phonetic or orthographic representation to the lexical level. Studies on bilingual processing suggest that activation of a lexicon in L1 or L2 (sequentially or simultaneously), the duration for processing words by a bilingual in each of the languages that are generally measured through the psycholinguistic approaches (e.g., Reaction time). In order to know the language representation and processing in bilinguals various models have been proposed.

2.1.3 Current Models on Bilingualism

Models proposed have different views such as, whether the bilinguals have same conceptual store or two independent stores for first language (L1), and second language (L2). Current research suggests that, at the lexical form level, the two languages have distinct and separate representations. However, at the conceptual level, the two languages have shared or overlapping representations (De Groot, 1992; Kroll & Stewart, 1994; Potter, So, Von Eckardt, & Feldman, 1984). This class of representational models is referred to as hierarchical models.

Hierarchical models of bilingual language processing presume that bilinguals have a shared conceptual representation for the translation equivalents in the two languages and with two separate lexical form representations for the two languages. These hierarchical models include word association and concept mediation models and these two hierarchical models are based on the Weinreich's classification of bilinguals such as subordinate and compound structure. Word association model is based on subordinate type which states lexical forms of L2 are connected only through the lexical form representation of L1 at the conceptual level. According to this model, the meaning of the L2 word is activated only if there is corresponding word activated in L1 respectively. On the other hand, the concept mediation model states the lexical form representation of L2 is directly connected to the conceptual representation. So, according to this model the L1 and L2 lexical forms are connected directly to the conceptual representation, hence the meaning of L2 word can be activated directly unlike the word association model (Potter et al., 1984). Another model was introduced in which both types of processing co-exist in the same individual. This model refers to revised hierarchical model (RHM) (Kroll and Sholl 1992; Kroll & Stewart, 1994), which states that strength between the lexical word forms in both languages and the connection to the conceptual representation are not symmetrical in nature. It assumes, L1 words are strongly connected to the conceptual representation, whereas the L2 words are strongly

linked to corresponding L1 words at the lexical level. As the bilingual gains proficiency in L2, the links at the lexical level gets weaker or it may be replaced by the conceptual link. So, the link between L2 word form and meaning (conceptual representation) gets stronger.

According to this model, the sequential bilinguals process their second language (L2) initially by word association model and once they gain proficiency in L2, they process by means of concept mediation model.

Kroll &Stewart (1994), also discuss the translation directional phenomenon. Two types of translational direction has been given, if the translation is from L1 to L2 then it is called as forward translation and if the translation is from L2 to L1 then it is called as backward translation. The latter is assumed to be quicker than the former and this shows the asymmetry in strength and connections between the lexical word forms and conceptual representation between L1 and L2.

They explained that this asymmetry is because of the concept mediation takes place only in L1-L2 (forward translation) direction. L1 directly activates the concept whereas in L2-L1, in the beginning learner's, concept mediation is restricted. Once the individual gains L2 proficiency to a greater level, then the connection between the L2 lexical form and the concepts becomes stronger and L2 word meaning can be accessed directly. However, the connection between L2 and L1 lexical

form remains, the conceptual link is stronger and there by L2-L1 translation should not differ from that of L1-L2.

Many researchers tested this hypothesis and they were unsuccessful to obtain the difference in translation direction as proposed by the RHM (De Groot et al., 1994;La Heij, Hooglander, Kerling, & Van der Velden., 1996; De Groot & Poot, 1997). Studies have also reported L2 words were mediated at the conceptual level by beginning learners (Altarriba & Mathis, 1997). Studies have also shown difference in the beginning learners, in terms of concrete words being more associated with meaning in a greater extent than the abstract words (De Groot, 1992, 1993).

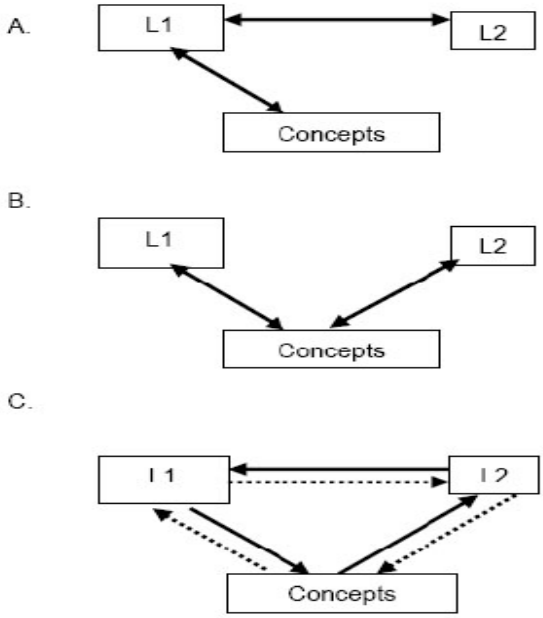

Figure 1. The hierarchical models. A: Word Association Model; B: Concept Mediation Model; C: Revised Hierarchical Model.

Figure1: Bilingual models

Source: Menenti. L. (2006)

Grainger and Frenck-Mestre (1998) had attempted to explain the task effects on masked translational priming in English-French bilinguals. They found that semantic categorization task had robust priming effect than lexical decision because the former task required access to semantic information. In the same line of research, Finkbeiner Forster, Nicol and Nakamura (2004) also attempted to explain this task effect thorough another model of translational priming called Sense model. According to the Sense Model, translation priming also depends on the overlap of the senses associated with the prime and target and that the semantic categorization strengthens this overlap.

The Sense Model assumes that most words are having one to many sense words related or many to one word related and that the range of senses that a word has will differ across languages. Translation equivalents share one sense (typically, the dominant sense), but may differ in the remaining senses. Translation priming depends on the ratio of primed to unprimed senses associated with the target. In order to produce priming effects, it is necessary to activate a sufficient proportion of the target senses. Priming from L1 to L2 is stronger because the L1 prime can activate a high proportion of the L2 target senses. However, priming from L2 to L1 is weaker because the L2 prime might activate only the dominant sense of the L1 target, and hence the ratio of primed to unprimed senses associated with the L1 target will be rather low, compared to that in the L1– L2 direction. This differential activation is

assumed to affect the degree of priming in type of task selected specifically more in a lexical decision task. As here, no category information will be present in lexical decision task therefore; no filtering effect will be present. This in turn increases the ratio of primed to unprimed senses in the L2–L1 direction and hence, no priming is observed. Whereas in semantic categorization task, the category provided is assumed to act as a kind of filter and limits the activation to just the category-relevant features of the target. Therefore, it increases the ratio of the primed senses to the un-primed senses in the case of L2–L1 priming. This explanation is referred to as the Category Restriction Hypothesis (Finkbeiner, Forster, Nicol, & Nakamura, 2004). To conclude, the sense model claims the notion of asymmetrical lexical-semantic representations between L1 and L2 in bilingual memory, which in turn causes the translation asymmetry in lexical decision. To account for the symmetric priming in semantic categorization, the sense model claims that the category serves as a filter to eliminate the representational asymmetry. The Sense Model is the only theory that is able to provide an account for the priming asymmetry and its dependence on task till date.

Another set of models called the connectionist models also attempt to explain the bilingual memory which include the following: BIA (Bilingual Interactive Activation) and BIA+.

2.1.4 BilingualInteractive Activation Model (Dijkstra& Van Heuven, 1998; Grainger &Dijkstra, 1992)

BIA is an extension to McClelland and Rumelhart's (1981) well-known proto-connectionist Interactive Activation model. An integrated lexicon is the basic assumption of this model and it has been very successful in extending single language effects to bilinguals. When a string of letters is presented to the BIA model, this visual input affects particular features at each letter position, which subsequently excite letters that contain these features and at the same time inhibit letters for which the features are absent. The activated letters next excite words in both languages for which the activated letter occurs at the position in question, while all other words are inhibited. At the word level, all words inhibit each other, irrespective of the language to which they belong. Activated word nodes from the same language send activation on to the corresponding language node, while activated language nodes send inhibitory feedback to all word nodes in the other language. The main function of the language nodes is to collect activation from words in the language they represent and inhibit active words of the other language. The activation of the language nodes reflects the amount of activity in each lexicon (Walter, van Heuven, Dijkstra &, 1998).

An extended version of BIA known as BIA+ (Dijkstra& van Heuven, 2002) has been proposed which speaks of:

- An automatic ('bottom- up') process within the bilingual lexico-semantic system, essentially driven by stimulus input involving

modification of the level of activation in the bilingual lexico-semantic system

- An intentional ('top-down') process that alters how the individual responds to signals coming from the bilingual lexico-semantic system, but does not modify activation levels within the system itself .

Limitations of BIA model

- The main problem with the BIA model is that though it speaks of language nodes it does not speak how they came to form in the first place.
- Though it speaks of an integrated lexicon, the division into two language nodes somehow blurs this approach.
- Even though researchers in general have agreed upon the presence of a separate semantic or conceptual level in bilingual memory structure there is no such concept in BIA.

Literature reviewed has given an insight in to the language representation and processing in bilinguals, and since the present study focused on healthy aging bilinguals, it is essential to understand the underlying processing mechanisms involved in healthy aging bilinguals.

2.2 Bilingualism and Aging

Aging is associated with cognitive and linguistic changes. Studying how the language has been processed in normal aging in healthy adults in the context of bilingualism is an active area of interest since 1980's in terms of cognitive aging (Craik & Masani, 1967; Riegel & Riegel, 1964**).** There are some aspects of cognition and language that decline over time and some grow and expand over time. For example, retrieval of lexical semantics was better than retrieval of phonological and orthographic information (Bruke and MacKay, 1997).

Studies conducted by Rajasudhakar & Shyamala, (2005) have also shown significant age related changes in cognitive linguistic tasks performed by bilinguals in the age range of 20 to 30 years and 70-80 years in the Cognitive linguistic assessment protocol (Kamath & Prema, 2001). Results indicated that younger adults were able to perform faster as well as more accurately in all the domains of Cognitive linguistic assessment protocol.

Kamath and Prema (2001) studied on cognitive linguistic interaction in healthy adults in the age range of 40-70 years. Results have shown decline in many of the cognitive and linguistic domains such as visual attention, perception and discrimination, episodic memory, working memory with advance in age.

2.2.1 Lexical retrieval in healthy aging

Studies have revealed variability in the pattern of decline with respect to cognitive (For example; attention, memory) in healthy older adults (Band, Riddernikhof, Segalowitz, 2002; Light & Burke, 1988; Lovelace, 1990; Salthouse, 1985a). One of the major complaints in

healthy aging individuals reported is the inability to retrieve the word (Burke and Shafto, 2004). Studies using picture naming task or word production task to assess lexical retrieval revealed that younger adults performed better than older healthy adults (Albert, Heller, & Milberg, 1988; Ardila & Rosselli, 1989; Au et al., 1995; Barresi, Nicholas, Connor, Obler, & Albert, 2000). One more area frequently reported to be difficult in healthy older individuals is the comprehension of complex material (Kemper, 1986; Kemtes& Kemper, 1997; Obler, Fein, Nicholas, & Albert, 1991; Stine, 1990; Waters & Caplan, 2001; Wingfield, 1999; Wingfield & Stine-Morrow, 2000).

Studies have shown decline in lexical access, confrontational naming, and word fluency tasks as age increases from middle age to old age (Bowles & Poon, 1985; LeBarge, et al., 1986; Bayles & Kaszniak, 1987).They also reported that, even though the normal healthy adults can retain memory store for vocabulary and semantic association in tasks like single word processing, word retrieval is slower and they also find very difficult in single words without contextual clues. Hence, elderly benefit more when asked to retrieve single words for a particular context.

Many studies reported that older adults perform poorer by making more errors during picture naming task than the young adults (Feyereisen, 1997). Studies done on healthy older adults during discourse have also reported that older adults use more number of filled pauses and ambiguous references than the younger adults (kemper, 1992; Schmitter-

Edgecombe &Vesneski, Jones, 2000).These dysfluencies can be attributed to difficulty in retrieving the words during the discourse. Vijaykumar & Prema (2007) examined on cognitive - linguistic flexibility in the normal healthy adults across the age range of 30 years to 80 years+. Results revealed that, as age increased, no significant deterioration reported in terms of cognitive - linguistic flexibility. Further, they also reported that as age advances, the time taken to retrieve the word and name picture in the picture naming task also increased.

Older adults perform poorer in naming objects and actions than younger adults in picture naming tasks (Nicholas, et al., 1997). Cooper (1990) reported that in picture description tasks older adults take more time to retrieve the names and use long filled pauses and more ambiguous terms which depicts their retrieval difficulty. Priming studies have shown impairment in explicit memory in aging (reviewed in Kausler, 1994; Light et al., 2000; Spaan et al., 2003) and profoundly impaired in Alziehemer'sdisease (AD) (Carlesimo and OscarBerman, 1992; Spaan et al., 2003).

2.2.2Loss of certain abilities in language in Bilinguals

Earlier studies in the context of bilingualism used grammatical judgment tasks to assess language knowledge and spontaneous speech samples were collected to assess language production in healthy older individuals concentrated on language loss or attrition. This attrition can

take place either in L1 or L2. However, L1 decline has been widely studied in monolingual healthy aging population. Studies have reported that decline in either L1 or L2 was attributed to two processes: Language loss occurring because of reduced usage of either L1 or L2 and this process refers to intra-language processes of attrition or loss. Other one refers to the influence of one language on the other which is known as inter-language process of attrition or loss.

Studies on language attrition or language loss depends on multiple factors, which include whether they are considering the language competence or language performance, do they talk about L1 attrition (individuals mostly use their L2) or L2 attrition (individuals who mostly use their L1) and have they specified the language proficiency in both the languages. Based on these issues, it has been documented that word retrieval is the major and the earliest noticed area that results in inability to quickly retrieve the target during the speech production (Anderson, 1982; DeBot, 1996; Hansen, 1999; Kopke, 2002; Magiste, 1986; Nakamura, 1997; Obler, 1982).

Self-reports of bilingual speakers experience contain descriptions of intermixing (code switching and or code mixing and word borrowed) of components of two languages in an utterance or discourse that resulted in lexical retrieval difficulties in either L1 or L2 attrition. Researchers have attempted to address the issue of lexical attrition in bilinguals with Finnish or English as their L1 and living in Sweden. Results revealed use

of L2 words during L1 production (Boyd, 1993).This suggests that lexical forms of L2 are better preserved than L1 lexical forms. Altenberg (1991) demonstrated the attrition of Russian in a Russian–English childhood bilingual. Cohen (1989) reported L1 attrition in Hebrew–English bilingual.

Many studies of language loss also considered other issues such as sociolinguistic aspects which includes attitude towards the language per se, degree of contact with speakers who use those language and use of language socially by the speaker were considered (De Bot, 2000; Hulsen, de Bot, & Weltens, 2002; Kaufman, 2000; Kenny, 1996; Kouritzin, 1999).

Hulsen, de Bot, & Weltens, (2002) studied on Dutch immigrants in New Zealand to examine the effects of social network on first-language maintenance using picture-naming task. Results revealed that there was a difference in performance noted in naming tasks between the first generation immigrants and that of monolingual Dutch speakers. Further, the performance in naming task decreased from the first generation to the second generation and to the third. They also found correlation in results between number of L1 contacts as well as contacts with the home country in naming performance.

The results obtained from several studies on bilinguals who experience decline in their L1 or L2 skills face word retrieval difficulties cannot be generalized in healthy elderly bilinguals and it has to be studied further.

2.2.3 Studies on Lexical retrieval in Bilinguals

Many researchers have conducted experiments on bilingual memory to investigate the lexical retrieval mechanism using tasks like lexical decision, picture naming and semantic categorization. These tasks provide the means to measure the dependent variable reaction time which is the time taken by the participants to respond either by making a decision in a lexical decision task, or to name a picture or to categorize the items like living or non-living. The studies done on bilinguals have utilized psycholinguistic experiments, priming with respect to different tasks in order to infer the nature of neural mechanisms which are responsible for the lexical retrieval from the memory store. Priming involves presentation of two stimuli in succession in which exposure to first stimulus influences a response in the second stimulus. The first stimulus is referred to as prime and the second stimulus as the target. Priming is an implicit memory effect and priming experiments can either have a facilitation effect wherein the prime and target are related and thus, reaction time will be reduced or it may have inhibitory effect where in the prime and target are not closely related to each other and thus results in increased reaction time for the target recognition. Particular manipulation in the way of presentation of the stimulus and the duration of the presentation of the prime and target results in masked priming. Any type of priming can be presented in the form of masked priming. Masked priming experiments are conducted to investigate the implicit

(non-conscious) processing mechanisms involved in bilinguals on lexical retrieval.

2.2.4 Age of L2 acquisition on bilingual lexicon

Sabourin, Christie, & Burkholder (2014) studied the role of age of acquisition (AoA) of language on the organization of bilingual mental lexicon. Masked priming paradigm was used to investigate early, automatic lexical processing at the semantic level in both the conditions which includes within-language semantic condition and a cross-language translation condition. They included four groups of participants (i) Native speakers of English and with minimal exposure to French; (ii) Late English–French bilinguals; (iii) Early English–French bilinguals; and (iv) Fourth group with simultaneous English–French bilinguals. Findings revealed significant translation priming effects only for simultaneous and early bilinguals, and significant positive correlation between AoA and translation priming effects. This was attributed to matched L2 proficiency of the early and late bilinguals.

2.2.5 Masked Priming Paradigm: A pathway for implicit (automatic) processing of word

The use of masking procedure taps on implicit processing and it minimizes the use of predictive or explicit strategies by the participant. In masked priming experiments the participants cannot consciously recognize a particular word prime. With respect to various features of a word it has been reported that either the semantic or conceptual

representation can have influence on word target items. Visual word recognition effects are hampered by the explicit processing like strategic, mnemonic, or attention processes in any kind of judgment task (lexical decision and / or semantic categorization) and hence Forster and Davis (1984) introduced masked priming paradigm to overcome this limitation. This would enhance the identification of some of the short-lived purely visual word recognition effects. Masked priming paradigm includes the presentation of certain pattern (e.g. hash marks) for duration of 500ms, followed by presentation of prime in lower case for a very short period of approximately 30-60 ms which is further followed by the target in upper case. The participant is required to perform the judgment task on the target words. The presentation of prime is rapid so as to prevent the awareness of the existence of the prime by the participant. This will avoid the processing being conscious or involvement of any attention-related cognitive processes since masked primes have been found to be processed from the visual percept or sub-lexical levels of word processing (Forster, Davis, Schoknecht & Carter, 1987).

The automatic and the volitional mechanisms can be induced in a semantic paradigm by altering the duration between the target and the prime (SOA).The automatic mechanism is activated when the SOA is kept short (below 250 milliseconds), and when the SOA is relatively large, the volitional mechanism is activated. Lexical access is slower in persons with aphasia (Blumstien, Milberg, & Shrier, 1982; Wayland &

Taplin, (1982); Abhishek & Prema, 2012). Automatic mechanism of lexical retrieval is preserved in persons with fluent aphasia and volitional lexical retrieval is spared in persons with non-fluent aphasia (Abhishek &Prema, 2012).Among these masked priming experiments, cross-language experiments and semantic priming have been conducted widely in bilinguals to study the representation and organization of language. The present study also employed two masked priming paradigms that are masked translation priming and masked repetition priming to investigate the implicit processing mechanism in healthy elderly bilinguals.

Cross language priming refers to the presentation of prime in one language (L1 or L2) followed by the target in other language (L1 or L2). Repetition priming is a procedural memory and it is manifested as change in the response for the target stimulus because of the previously encountered stimulus of the same as a prime.

Masked translation priming refers to the presentation of prime for a very short duration in one language followed by the translation of the same word as a target in other language. It can be presented either in L1-L2 direction where in the prime being presented in L1 for a brief duration and followed by the presentation of clearly visible target in L2 or L2-L1 direction in which the masked prime being presented for a brief duration in L2 followed by the visible target in L1.

Masked repetition priming paradigm refers to the presentation of the masked prime word in one language for a short duration of the time

followed by presentation of the same word as target and in a same language as that of prime in a clearly visible form. In this type of experiment, since both the prime and target consists of the same word, they share all the features (orthographic, lexical semantic representations) and the target would have been pre-activated by the prior presentation of the prime. Hence, the priming effects seen are very robust in nature and results in faster retrieval of the target. It is often functionally and neurally dissociated from performance on explicit memory tasks, which directly measure conscious recall or recognition of recent events. Hence, repetition priming has been widely studied in normal aging and pathological aging as in Alzheimer's disease, in those where the changes in explicit or strategic processing can range from mild to severe degree.

2.2.5.1 Advantage of using masked priming

Priming effects were not seen evidently when the words overlapped orthographically (Colombo, 1986; Martin & Jensen, 1988). However, when the experiments were manipulated and prime words were masked by the use of masking procedure, a reliable facilitation effects were reported (Forster et al., 1987). This type of experimental priming paradigm suggests that masked priming taps on the early processing mechanism (implicit) which takes place during the word retrieval and the computation will be faster which was found to be absent in cases of prime being presented in a clearly visible manner (conscious).

Also, it clearly differentiates from the strategic processing which uses conscious perception of the prime words (Neely, Keefe, & Ross, 1989).

2.2.5.2 Visibility of the prime

The visibility of the prime determines the type of processing (implicit or explicit) used by the participants. The level of awareness of the prime provides the information on automatic processing.

2.3Studies on Masked translation priming experiments

The masked translation priming experiments using lexical decision task in bilinguals have shown that the prime being presented in L1 (dominant language) facilitates the retrieval of the target in the L2 (non-dominant language) but not in the other direction of translation (L2-L1) (de Groot &Nas, 1991; Gollan, Forster, & Frost, 1997; Jiang, 1999; Jiang & Forster, 2001; Keatly, Spinks, & De Gelder, 1994; Williams, 1994).However, the studies carried out by Jiang and Forster (2001), have reported in other way that subliminal primes in the non-dominant language (L2) facilitates recognition of the target in the dominant language (L1) when an ‘‘old-new’’ episodic recognition task was used, but, again, not when lexical decision was used. Jiang and Forster (2001), referred this effect as the "separate memory systems account"(p. 3) and accounts for the different interpretation of bilingual lexical processing.

Wang & Forster (2010) carried out a study to examine whether the translation effect only occurred to exemplars, ruling out the possibility of

congruence effect, and the role of the category information in translation priming. Results obtained were in support of the assumptions of the sense model. Recently, Yeong Ko and Wang (2014) conducted two masked priming experiments using lexical decision task in Korean-English bilinguals to investigate how they read compound words. Compound words served as the target which was preceded by the visual primes. One of the experiments had within-language prime-target pairs and the other had cross-language prime (L2)-target (L1)-prime pairs with different prime durations (36, 48 and 100 ms). Within-language priming experiment showed that Korean compound words are processed depending on the morpheme unit rather than the syllable form. Cross-language priming experiment revealed that there is a cross-language activation of L1 (Korean) morphemic information while reading the L2 (English) compound words. They concluded that bilingual readers are more sensitive to morphological information than form information while reading compound words in both Korean and English. Authors also suggest that there is an automatic L1 translated morpheme activation during the processing of L2 compound words irrespective of the scripts of L1 and L2. The difference in the prime duration accounted for the type of information activated for reading. At lesser prime durations (36 and 48 ms), phonological and morphological information of L1 are activated regardless of semantic relatedness whereas at greater prime duration (100 ms), semantic information constrains the morphological activation of L1 while reading complex words in L2.

2.3.1 Asymmetry in masked translation processing

Studies have also reported asymmetry in translation priming with respect to the task used. Finkbeiner, Forster, Nicol, and Nakamura (2004) conducted four experiments. The study was carried out on 20 Japanese-English bilinguals. In the Experiment1 they found masked translation priming effects were larger in L2-L1 direction in a semantic categorization task and bilinguals were able to process in L2 sufficiently. This asymmetry is explained through the form representation and their connection strength to the meaning representation and further they (Finkbeiner, Forster, Nicol, and Nakamura, 2004) proposed that L2 form-meaning connections and their strength did not have limitations while processing L2-L1 priming. Experiment 2 revealed the masked primes in the dominant language (L1) had a facilitation effect in L1-L2 direction for a lexical decision task but however, it was not seen in L2-L1 masked translation priming. The results obtained reveals that in masked translation priming effects were asymmetrical for a lexical decision task and it was symmetrical when it was semantic categorization task. They attribute this to the lexical semantic links which is stronger in L1 to L2 direction for lexical decision task but no other way (L2-L1). According to that the L2-L1 translational priming does not takes place because of inadequate amount of lexical semantic representation by the L2 prime, whereas in semantic categorization task the information is translated and used to generate the decision with respect to the task category and this restriction results in enhancement of L2 prime.

The assumptions were tested in a within–language experiments where in the pairing were done using many-sense words with fewer sense words for example: ‘head’ and ‘skull’. Results revealed that there was larger priming effects in terms of L1-L2 direction but not the other way and with respect to semantic categorization task, the priming effects seen were bidirectional (L1-L2 and L2-L1).

2.3.2 Translation Equivalent Bilinguals

Grainger &Frenck-Mestre (1998) carried out the masked translation priming experiment on English–French high proficient bilinguals using two tasks that is semantic categorisation and lexical decision tasks. Results indicated facilitatory effect observed for the prime stimuli that were non cognate translation equivalents of the targets (For example:arbre–tree) rather than for the unrelated primes (For example: balle–tree). These priming effects were evident with a prime being masked by forward and backward masks and prime was presented for a very short duration (29-43ms) of time. With respect to semantic categorization task, using the same stimuli there was a significant and stronger translation priming effects observed than that of the lexical decision task. The results suggest that priming effects obtained for highly proficient bilinguals on semantic categorization can be attributed to semantic representations in memory and not because of the form-level representational links between translation equivalents.

2.4 Studies on Masked Repetition Priming Experiments

Repetition Priming and Automaticity share many common features, they both can be observed because of the previously encountered stimulus. They result from a common storage and retrieval representation based on the individual exposures to specific item. The repetition priming is the first few steps on the way to automaticity theoretically and empirically, they both share three features in common (a) Depending on the number of exposure of a particular stimulus increases the processing speed, (b) the benefit from repeated exposures is specific to individual items, and (c) this benefit differs based on the tasks used in the experiment and also on the underlying associations between stimuli and the interpretations given to them.

2.4.1 Repetition priming on hand- written words

Masked repetition priming experimental studies were carried out using handwritten words (Cristina, Manuel, Carmen & Manuel, 2011). They reported that masked repetition priming were larger in semantic categorization tasks for words referring to man-made objects than for natural objects and in lexical decision task, a highly significant masked repetition priming effects were seen with handwritten prime.

2.4.2 Repetition Priming in Young versus Old age population

Wiggs and Martin (1994) found that young and older native English speakers who were not familiar with the Turkish language showed equivalent repetition priming for English words; however, the

young demonstrated some priming for previously presented Turkish words, while the older group did not.

2.4.3 Repetition Priming on Normal aging and Pathological population

Earlier studies have shown that repetition priming experiments was immune to the effects of aging and greatly reduced in Alzheimer's disease (AD). Further as more number of studies came up, the findings of the earlier studies appeared to be less clear and further it was misleading in cases with AD.

Fleischman, Debra, Gabrieli, Reminger, Vaidya and Bennett (1998) studied on object decision priming in Alzheimer's disease and normal elderly adults in two conditions (implicit and explicitly). Findings revealed that normal healthy elderly participants performed significantly faster and were more accurate in categorising the real and non-real objects and in case of Alzheimer's disease (AD) participants, the strategic or the explicit processing was impaired. However, in terms of real objects results suggested that AD patients had an intact repetition priming.

2.4.4Repetition priming and frequency attenuation in lexical access

Forster, Kenneth, Davis, Chris (1984) conducted six experiments to investigate repetition priming and frequency attenuation in lexical access with 164 college students. Repetition priming effects in lexical decision tasks are stronger for low-frequency words than for high-frequency words. It was posited that frequency attenuation is a product of

the involvement of the episodic memory system in the lexical decision process. This hypothesis was supported by the demonstration of constant repetition effects for high- and low-frequency words when the priming stimulus was masked; the masking was assumed to minimize the influence of any possible episodic trace of the prime. It was further shown that long-term repetition effects were much less reliable when the S was not required to make a lexical decision response to the prime. When a response was required, the expected frequency attenuation effect was restored. It is concluded that normal repetition effects consist of 2 components: a very brief lexical effect that is independent of frequency and a long-term episodic effect that is sensitive to frequency.

2.4.5Masked repetition priming effects on naming in aphasia

It has been suggested that lexical access deficits in aphasics may be the result of impaired implicit processing (automatic activation) mechanism of networks that support the language processing system. This raises the question whether the networks can be rebuilt directly through the implicit or automatic processing rather than through the impaired explicit processing.

Silkes, Dierkes, Kendall (2012) investigated masked repetition priming as a treatment for anomia in a single subject case study. Client underwent 22 sessions of training and training involved repeated presentation of the masked repetition prime target pairs prior to the attempts at naming those

pictures. Stimulus also included untrained items in equal number but presented without primes.

Repeated naming probes administered before, during, and after treatment were used to measure effects of training (naming trained stimuli) and generalization (naming within and across semantic categories). Findings revealed with training naming of trained items were improved in one category, along with that a pattern of improvement was also observed in the other category but it was not significant. There was also a medium cross category generalization effect. With respect to untrained items, no generalization effect was seen within semantic categories. However, the use of masked repetition priming has shown positive change in naming performance over time with training and hence it can be used as a potential strategy for improving word retrieval in individuals with naming difficulty.

CHAPTER III

METHOD

The main objective of the present study was to investigate the effects of masked translation and masked repetition priming on lexical retrieval in bilingual healthy elderly adults who are native speakers of Kannada language and have learnt English language in a formal instruction context in schools.

Objectives of the study

The main objective of the study was to investigate the implicit lexical retrieval mechanism using masked priming across age in normal healthy aging bilingual adults.

Further, the study also examines,

1. Comparison between the masked translation priming and masked repetition priming on lexical retrieval.
2. The directional effects of masked translation priming on lexical retrieval in L1-L2 and L2-L1 using reaction time and accuracy measures.
3. The effects of masked repetition priming on lexical retrieval in L1 and L2 conditions.

3.1 Participants

Twenty Kannada-English normal healthy elderly bilingual adults in the age range of 60 to 70 years participated in the study. Participants were divided into two groups with an age interval of 5 years each. Group 1 consists of participants in the age range of 61-65 years and Group 2 consists of participants

in the age range of 66-70 years. Each group had 10 participants with equal distribution of gender (M=5; F=5)

3.1.1 Criteria for the selection of participants

- All the participants were native speakers of Kannada Language (L1) and have learnt English Language (L2) as medium of instruction in the context of school.
- All the participants were screened for visual acuity using Snellen chart (Snellen, 1862).
- Language proficiency in both the languages (L1 and L2) of all the participants were screened using Language Experience Proficiency Questionnaire (Ramya & Goswami, 2009).
- All the participants were screened for cognitive status using Mini Mental Status Examination (MMSE) Folstein, Folstein and Mc Hugh (1975). Only those participants who scored equal to 25 or above 25 were included in the study.

Table 2

Participants details

Subjects	**Age/Gender**	**Language Proficiency in L1**	**Language Proficiency in L2**	**Qualification**	**Occupation**
1	61y/M	Native like	Good	UG	Engineer
2	62y/M	Native like	Good	UG	Bank Accountant
3	63y/M	Native like	Good	UG	Bank Manager
4	64y/M	Native like	Good	PG	Engineer

5	65y/M	Native like	Good	UG	Engineer
6	66y/M	Native like	Good	UG	Theatre Artist
7	67y/M	Native like	Good	UG	Engineer
8	68y/M	Native like	Good	UG	Officer
9	69y/M	Native like	Good	UG	TheatreArtist
10	70y/M	Native like	Good	PhD	Retired Lecturer
11	61y/F	Native like	Good	UG	Retired Lecturer
12	62y/F	Native like	Good	UG	Bank Employee
13	63y/F	Native like	Good	UG	Retired Lecturer
14	64y/F	Native like	Low	UG	House wife
15	65y/F	Native like	Good	PG	House wife
16	66y/F	Native like	Good	UG	Retired ITI officer
17	67y/F	Native like	Good	UG	Staff Nurse
18	68y/F	Native like	Good	UG	Business
19	69y/F	Native like	Low	UG	House wife
20	70y/F	Native like	Good	PG	Retired Lecturer

Notes: L1- Kannada Language, L2 – English Language.

All the participants rated as 4 for L1 which denotes (Native like proficiency in Kannada Language) and rated as 3 for English Language and the proficiency was rated based on 4 parameters – Understanding, Speaking, Reading and Writing. Also, all the participants were native speakers of Kannada

language and have learnt English language in a formal instruction context in schools of Mysooru city.

3.1.2 Study Design

Cross sectional and counter balanced design was employed to study the effect of two types of masked priming on lexical retrieval in healthy elderly adults.

3.1.3 Paradigm

Masked translation and masked repetition priming paradigms are the two types used in the present study. Four word lists were prepared consisting of 20 pairs of stimuli in each list. The list included words containing both living and non-living features in equal number.

3.1.4 Stimuli

Word lists were taken from the ARF 3.47 (Prema, 2010 - Development of a test for Assessment of language Proficiency in Bilingual Adults through Lexical Priming. Departmental Project, All India Institute of Speech and Hearing, Mysore AIISH).

Four word lists each consisting of 20 pairs (10 living and 10 non-living pairs) were prepared. The first two word list pairs served as stimuli material for masked translation conditions. Third and fourth word list pairs served as stimuli material for masked repetition conditions. The first word list pairs were based on translation equivalents from Kannada (L1) - English (L2), and the second list included translation equivalent

pairs from English (L2) to Kannada translation (L1). Third list was prepared from the first list and only Kannada words were taken (L1) and fourth list was prepared from the words taken from second list which included word pairs in English (L2).

3.1.5 Instrumentation for the study

The Stimuli were presented on Hewlett Packard 12 inch laptop with windows 8 operating system using a freely downloadable DMDX software (Forster and Forster 2003) developed by Jonathan and Ken Forster in the Department of Psychology at the University of Arizona. The timing of the presentation of visual stimuli (word-pairs) was controlled for the reaction time measures using DMDX software.

3.1.6 Presentation of stimuli

For masked translation and masked repetition conditions, the hash marks (###), prime and target words were presented in the Courier New Font style for English words and Tunga font style for the target words in Kannada. The prime words in both Kannada and English were presented with a font size of 36 and target, hash marks (###) were presented with a font size of 48. The prime words in English were presented in a lower case letters. All the stimuli were presented in bold font.

All the participants were given practice trials with 4 word pairs in all the four conditions, i.e., masked translation from L1- L2 direction, L2-L1 direction and masked repetition in L1 and L2 conditions to

familiarize the participants with the task. The word pairs in each list were randomly presented on a computer screen using DMDX software. The masked conditions were presented as shown in the table 3, i.e., initially hash marks (##) were presented for 500 msec followed by prime stimulus presentation for 50 msec. The computer screen was blank during the time interval of 50 msec. The duration between the onset of the prime and onset of the target is called as Stimulus Onset Asynchrony (SOA) and it constitutes 100msecs (duration of prime- 50ms and duration of interval before after the prime- 50 ms). Followed by SOA, target word was presented for a duration of 500 msec. The response duration of 4000ms was given for the participants to respond by categorizing the target words into living or non-living by pressing either the right or left control key on the keyboard.

3.2 Procedure

The participants were tested individually in a relatively quiet environment. Semantic categorization task was used. All the participants were subjected to all four different conditions of masked priming. Each participant performed on the two masked translation priming conditions first followed by the two masked repetition priming conditions. Each participant received the masked translation of L1-L2 condition first, in which prime was in L1 and target was presented in L2. In the second condition, the participant received the masked translation priming condition in the direction of L2-L1 wherein prime

was presented in L2 and target was presented in L1. Third and fourth conditions were based on masked repetition priming. In the third condition, the prime and target was presented in L1 and in the fourth condition, the prime and target was presented in L2. All the conditions are tabulated in table 2.

3.2.1 Instructions to participants

The participants were instructed to categorize the target item into living or non-living on lexical retrieval. They were asked to press 'right' control key if the target belongs to living category and press 'left' control key if the target word belongs non-living category.

Table 3

Presentation of stimuli in all the four conditions and target responses

Conditions	**Hash marks (500 ms)**	**Prime (50 ms)**		**Target (500 ms)**	**Response (4000ms)**
MTL1L2	#####	**ಕೋತಿ**	**Inter Stimulus Interval**	**MONKEY**	**Right control key (Living)**
MTL2L1	#####	**tumbler**	**(50 ms)**	**ಲೋಟ**	**Left control key (Non-living)**
MRL1	#####	**ಕೋತಿ**		**ಕೋತಿ**	**Right control key (Living)**
MRL2	#####	**tumbler**		**TUMBLER**	**Left control key (Non-living)**

Note: MT- Masked Translation, L1-Kannda, L2- English, and MR- Masked Repetition.

The hash marks (####), primes and targets appeared on the center of the computer screen. All the primes were either translated or repeated form of the targets and represented in an orthographic form. Each participant was given a response time for duration of 4000 msec to respond after the presentation of target. If the subject failed to respond within 4000 ms duration, then the next stimulus appears on the screen and the item will be recorded as no response (-4000ms). Participants were instructed to respond as quickly and as accurately as possible.

A pilot study was conducted before finalizing the stimuli and the procedure. After completion of each list examiner asked the participants to say about the visibility of the prime to know the degree of awareness of the prime.

3.3Scoring and Analysis

The stimuli were coded as "+" for all the living items and "-" for all the non-living items and the responses were coded to the key board in a similar manner. The control keys in the keyboard were coded as Right control key for the living items Left control key was coded for non-living items. Responses were recorded as the individual press the right or left control key.

Correct responses were indicated by a "positive" value in the recorded reaction time, incorrect responses were recorded by a "negative" value in the recorded reaction time and "No responses " were indicated by negative sign at 4000ms (-4000ms).

The responses were analysed for reaction time and accuracy. Each correct response of reaction time of an individual for each word list pairs was averaged.

Accuracy measures were calculated for each individual and for both living and non-living items separately. Correct responses were scored as "1" and incorrect responses and no responses were scored as "0". Number of correct responses out of 10 in each word list was analyzed separately for living and non-living items with respect to accuracy measures.

Two to three practice trials were provided for each individual before carrying out the actual experiment to familiarize the task.

For each of the paradigm, reaction time scores was calculated separately and later combined scores of all the paradigms were also calculated. All the scores obtained were tabulated and subjected to SPSS software version IBM 21 for statistical analysis.

The data was subjected to descriptive statistics and based on the normality criteria, parametric and non-parametric tests were carried out.

CHAPTER IV

RESULTS AND DISCUSSIONS

The main objectives of the study were to investigate the implicit lexical retrieval mechanism in Kannada English normal elderly bilinguals.

Further, the study intended to examine,

a) To study the implicit retrieval mechanism using the masked translation and masked repetition priming in healthy elderly bilingual adults.
b) The directional effects of masked translation priming on lexical retrieval in L1-L2 and L2-L1 using reaction time and accuracy measures.
c) The effects of masked repetition priming on lexical retrieval in L1 and L2 conditions.

The study was designed using cross sectional and counter balanced design.

The dependent variables in the study were reaction time and accuracy. The independent variables in the study included, masked priming paradigms (masked translation and masked repetition) and language directions within each paradigm used in the study (L1-L2, L2-L1 and L1 and L2). The results are discussed under the following sections.

A. Reaction time
B. Accuracy

For the statistical analysis, SPSS (Statistical Package for the Social Sciences) – Version 21.0 software was used. Descriptive statistics, parametric and non-parametric tests were used to derive statistical values. Descriptive statistics was used to calculate the mean and standard deviation measures (Overall, age wise and gender wise) of the reaction times obtained. Further, the data which satisfied the Shapiro-Wilk test of normality condition, the parameters were analysed with parametric tests (Mixed ANOVA, Repeated measure ANOVA, paired samplest-test) have been used. The data which did not satisfy the Shapiro-Wilk test of normality condition were analysed using non-parametric tests (Wilcoxon Signed Rank test and Mann Whitney U test). In the present study, the reaction time measures obtained satisfied the Shapiro-Wilk test of normality condition and hence, the parametric tests were used and accuracy measures did not satisfy the Shapiro-Wilk test of normality condition, hence, non-parametric tests were employed. These results are discussed independently.

A total of four conditions were employed in the present study to examine the objectives. Reaction time and accuracy for all the four conditions was analyzed and then compared to examine the objectives as mentioned above.

The list of conditions considered is as follows:

1. Masked translation priming in L1-L2 condition – Prime in L1 and target in L2 (MTL1L2).
2. Masked translation priming in L2-L1 condition – Prime in L2 and target in L1 (MTL2L1).

3. Masked repetition priming in L1 condition – Prime in L1 and target in L1 (MRL1)
4. Masked repetition priming in L2 condition – Prime in L2 and target in L2 (MRL2).

Table 4
Overall Mean, Median and SD values of reaction time

	Min	**Max**	**Mean (N=20)**	**Median**	**SD**
MTL1L2L	767.56	955.85	844.33	819.68	173.98
MTL1L2NL	732.82	995.91	852.53	827.00	202.27
MTL2L1L	621.39	675.48	651.40	643.69	102.81
MTL2L1NL	708.62	806.72	748.87	741.89	140.32
MRL1L	646.58	705.58	661.59	664.16	112.22
MRL1NL	700.03	739.96	721.32	703.74	146.54
MRL2L	723.01	881.14	809.11	733.79	182.82
MRL2NL	871.22	1025.93	939.72	896.91	248.45

MTL1L2: Masked Translation priming in L1-L2 condition; MTL2L1: Masked translation priming in L2-L1 condition; MRL1: Masked repetition priming in L1 condition; ML2: Masked repetition priming in L2 condition; L: Living items; NL: Non-living items

Objective 1: To study the lexical retrieval using masked translation and masked repetition priming paradigms.

The mean reaction time is lower in masked repetition priming task in L1 condition than masked translation task in L1-L2 direction, and masked translation priming tasks had lower reaction time in L2-L1 condition than masked repetition priming tasks in L2 conditions in the present study. The

overall mean reaction time is found to be low for masked repetition priming of L2 condition (MRL2L) (651ms; SD = 102.81) and overall the highest mean reaction time obtained in MRL2NL condition (939.72ms; SD = 248.45). In general, the overall reaction time is observed to be shorter for the retrieval and categorization of living than non-living items in both masked priming conditions. It has been depicted in Figure 1.

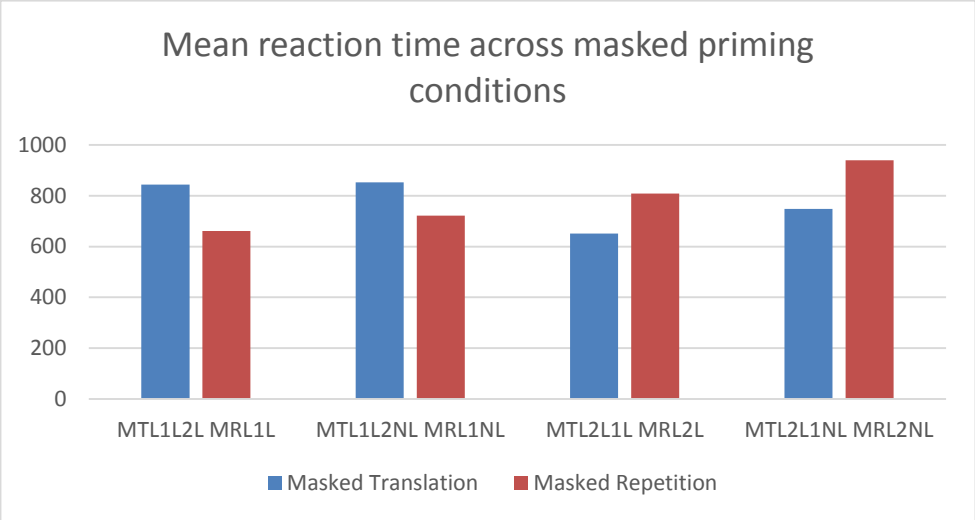

Figure 2. Mean reaction time in different conditions across masked translation and masked repetition priming.

Table 5
Paired samples t-test irrespective of age and gender (Overall)

Conditions	t	Sig. (2-tailed)
RML1L2L - RMRL1L	4.752	.000
RML1L2NL - RMRL1NL	3.017	.007
RML2L1L - RMRL2L	-4.884	.000
RML2L1NL - RMRL2NL	-4.113	.001
RML1L2L - RML2L1L	7.252	.000

RML1L2NL - RML2L1NL	2.688	.015
RMRL1L - RMRL2L	-3.301	.004
RMRL1NL - RMRL2NL	-4.574	.000

Note: ML1L2- Masked translation in L1-L2 direction, ML2-L1- Masked translation in L2-L1 direction, MR- Masked repetition, L1- Kannada, L2- English, L- Living and NL- Non-living.

Analysis of paired samples t-test showed significant difference between all the pairs across parameters. There was a significant difference obtained between the masked translation in L1-L2, L2-L1 direction and masked repetition condition (L1 and L2) across living and non-living as feature ($p < 0.05$).

Objective 2: To examine the lexical retrieval in both language directions (L1 to L2 and L2 to L1).

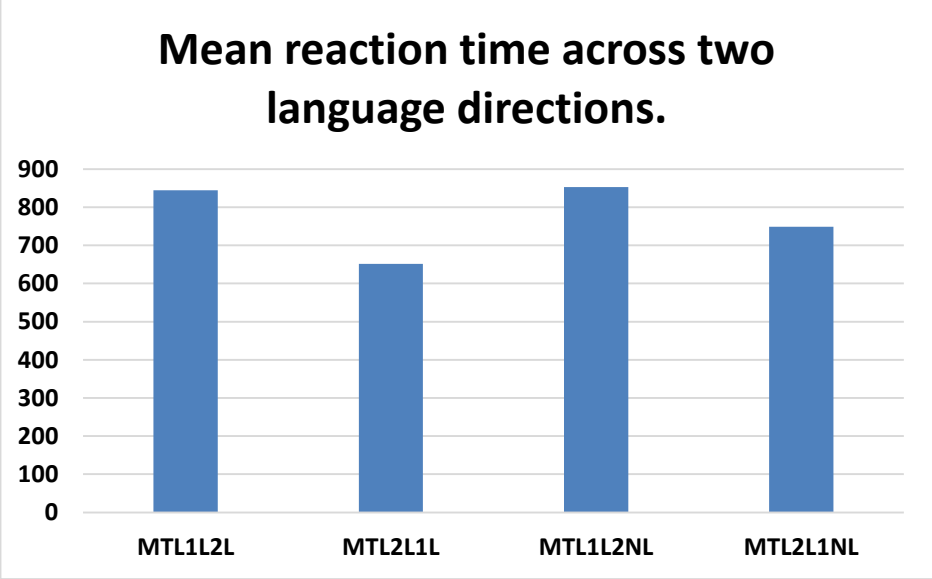

Figure3. Mean reaction time across two language directions.

The mean reaction time is shorter in L2-L1 direction in both living and non-living conditions. It shows that L2-L1 direction has facilitated for faster lexical retrieval in categorizing living versus non-living.

Objective 3: The effects of masked repetition priming on lexical retrieval in L1 and L2 conditions.

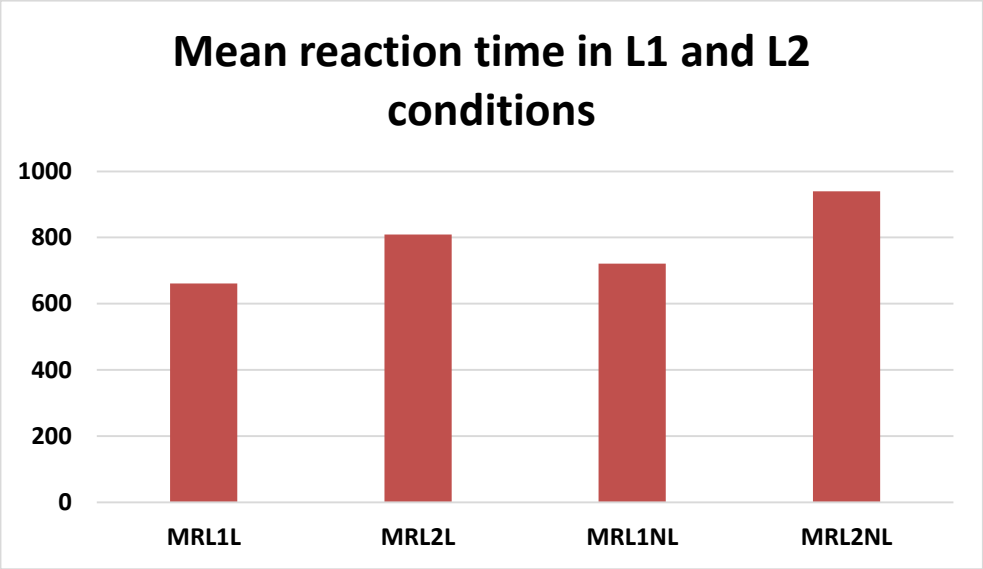

*Figure 4.*Mean reaction time in L1 and L2 conditions.

The mean reaction time is shorter in L1 in both living and non-living conditions. The lexical retrieval was faster in L1 than in L2 in masked repetition priming paradigm.

Mixed ANOVA was performed to see the effect of within subject variables (paradigms, languages and features) and the between subject variable age and gender has been considered separately. The main effects and interaction effects obtained by Mixed ANOVA are tabulated in Table 6 and findings revealed that there was no significant main effect of age ($F(1,18) = 0.012$, $p >$

0.05) which means test performance between the 2 age groups were not significant for reaction time measures. In the main effects for the reaction time measures with respect to within subject factors, except for the features ($F(1,18)= 15.592$, $p < 0.05$) the reaction times of the healthy elderly bilinguals had a significant difference in terms of the deciding feature (living versus non-living). There was no significant difference in terms of two paradigms i.e., masked translation and masked repetition priming conditions ($F (1, 18) = 0.282$, $p > 0.05$), no significant difference between the two languages (L1 and L2) ($F (1, 18) = 0.994$, $p > 0.05$) seen for reaction time measures in healthy elderly bilingual adults. However, there was a significant interaction effects obtained between the two priming paradigm (masked translation and masked repetition) conditions and the two languages (L1 and L2) ($F (1, 18) = 25.263$, $p < 0.05$) and significant interaction effect was seen between the two languages (L1 and L2) and for features (living versus non-living) ($F (1, 18) = 27.808$, $p < 0.05$) for the reaction time measures in healthy elderly bilingual adults. There was no interaction effects observed for paradigms and features ($F (1, 18) = 3.377$, $p > 0.05$) and for paradigms and languages and features ($F (1, 18) = 0.123$, $p > 0.05$) used in the study.

Table 6

Main effects and Interaction effects of between subject variable as age and within subject variables.

Main effects	**F (1,18)**	**p value**
Age	0.012	0.914
Paradigms	0.282	0.602

Languages	0.994	0.332
Features	15.592	0.001
Interaction Effects		
Paradigms * Languages	25.263	0.000
Languages * Features	27.808	0.000

Further, Repeated measure ANOVA was carried out to compare between the two age groups and genders.

Table 7
Repeated Measure ANOVA interaction effects results with respect to age

	Age Group 1 (61-65 years)		**Age Group 2 (66-70 years)**	
Interaction Effects	**F**	**Sig.**	**F**	**Sig.**
Paradigms * Language	17.002	.003	11.86	.007
Language * Features	10.63	0.010	10.10	.011

Significant interaction effects were seen between the variables for paradigms and languages and for languages and features across two age groups considered ($p < 0.05$).

Table 8

Paired samples t-test: Age wise (61-65 years) and (66-70 years) across two paradigms and two language conditions.

	Age group1 (61-65)		**Age group1 (65-70)**	
Conditions	**t**	**Sig. (2-tailed)**	**T**	**Sig. (2-tailed)**
RML1L2L - RMRL1L	3.704	.005	2.986	.015
RML1L2NL - RMRL1NL	1.217	.255	3.188	.011
RML2L1L - RMRL2L	2.839	.019	4.010	.003
RML2L1NL - RMRL2NL	3.147	.012	2.896	.018
RML1L2L - RML2L1L	4.518	.001	5.924	.000
RML1L2NL - RML2L1NL	1.059	.317	2.661	.026
RMRL1L - RMRL2L	2.542	.032	2.050	.071
RMRL1NL - RMRL2NL	3.289	.009	3.197	.011

Paired samples t-test results for the reaction time measures in age group1 shows that, there was a significant difference across the two paradigms except for (RML1L2NL - RMRL1NL t=1.21, p >0.05) and for the two language directions except for (RML1L2NL - RML2L1NL t=1.059, p > 0.05) used in the study. For the age group 2, significant difference was observed across the two paradigms used, and also for the two language directions except for the pair (RMRL1L - RMRL2L t=2.05, p > 0.05).

Age wise: Mean Reaction time measures SD values based on descriptive statistics.

1. Performance of healthy elderly bilinguals on two priming paradigms (masked translation and masked repetition priming) using semantic categorization task.

a. *Reaction time:* The overall mean, and standard deviation (SD) of the reaction time across two priming paradigms, two language directions were obtained using descriptive statistics.

Table 9
Reaction time with respect Age (descriptive)

Conditions	**Age group 1 (61-65)**		**Age Group 2 (66-70)**	
	Mean	**SD**	**Mean**	**SD**
MTL1L2L	826.9627	189.11	861.70	165.73
MTL1L2NL	815.69	170.78	889.38	232.78
MTL2L1L	670.0703	120.07	632.74	84.39
MTL2L1NL	775.76	180.46	721.98	85.99
MRL1L	648.33	124.85	674.85	102.99
MRL1NL	739.96	178.27	702.67	113.07
MRL2L	801.04	194.49	817.18	180.53
MRL2NL	924.66	206.87	954.77	294.98

MTL1L2: Masked Translation priming in L1-L2 condition; MTL2L1: Masked translation priming in L2-L1 condition; MRL1: Masked repetition priming in L1 condition; ML2: Masked repetition priming in L2 condition; L: Living items; NL: Non-living items.

The mean reaction time measures were observed to be almost similar. There was no much difference in performance with respect to two groups of

ages noticed across the conditions. All the participants have performed the task within 1000ms.

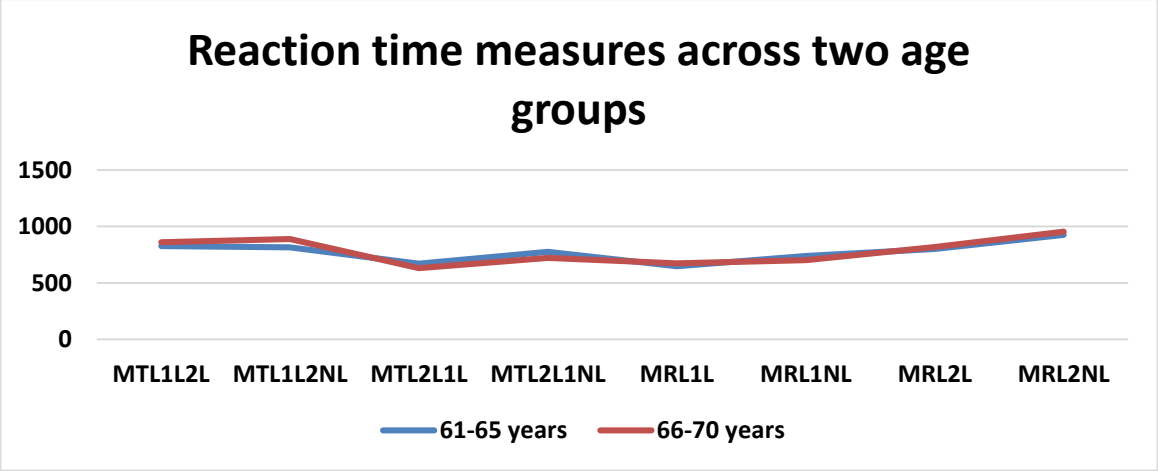

Figure 5. Reaction time measures across 8 conditions performed by two age groups.

Table 10

Reaction time across gender (descriptive)

Conditions	**Gender (Male)**		**Gender (Female)**	
	Mean	**SD**	**Mean**	**SD**
MTL1L2L	782.28	154.73	906.38	177.21
MTL1L2NL	757.83	138.12	947.23	217.64
MTL2L1L	643.02	111.36	659.78	98.77
MTL2L1NL	740.06	129.82	757.67	156.66
MRL1L	677.83	131.79	645.35	92.90
MRL1NL	722.93	178.15	719.70	116.58
MRL2L	737.09	127.51	881.14	206.82
MRL2NL	871.22	172.63	1008.22	300.14

MTL1L2: Masked Translation priming in L1-L2 condition; MTL2L1: Masked translation priming in L2-L1 condition; MRL1: Masked repetition priming in L1 condition; ML2: Masked repetition priming in L2 condition;L: Living items; NL: Non-living items.

The reaction times for masked repetition were better than masked translation for living features in both males and females. In terms of categorizing the non-living items, there was difference in performance in males and females and also with respect to the paradigms used. That is, the reaction times were shorter in males for the masked translation priming, whereas females performed better in masked repetition priming conditions.

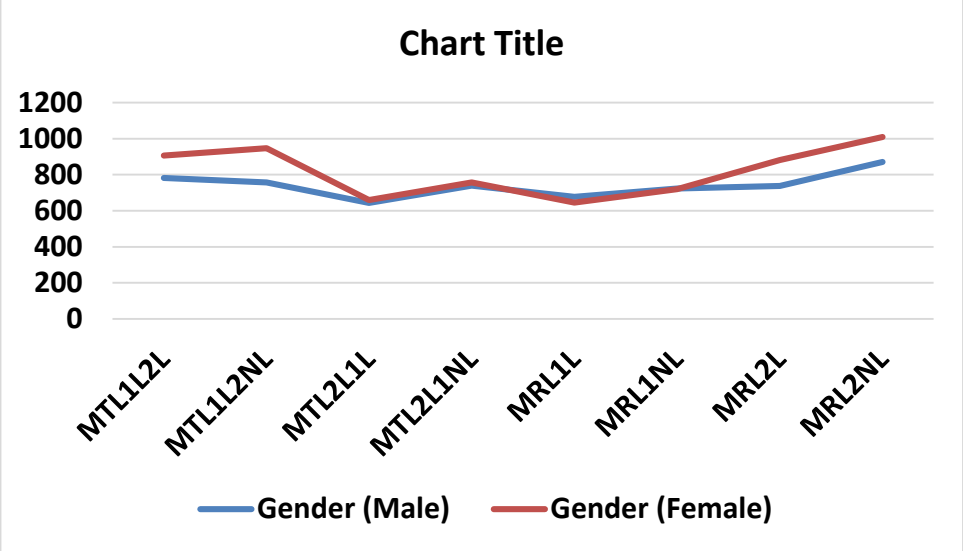

Figure 6. Reaction time measures across 8 conditions performed by males and females.

Mixed ANOVA was employed to the present study to see the effect of within subject variables (paradigms, languages and features) and the between subject variable gender. The main effects and interaction effects obtained by Mixed ANOVA are tabulated.

Table 11

Mixed ANOVA – Between subject variable as gender and three within subject variables.

Main effects	**F (1,18)**	**p value**
Gender	1.657	0.214
Paradigms	0.292	0.596
Languages	0.942	0.345
Features	15.86	0.001
Interaction Effects		
Paradigms * Languages	32.86	0.000
Languages * Features	32.53	0.000
Paradigms * Languages * Gender	6.64	0.019

As tabulated above, there was no significant main effect of gender (F (1, 18) = 1.657, $p > 0.05$) which means test performance between the 2 gender (male and female) were not significant for reaction time measures. In the main effects for the reaction time measures with respect to within subject factors, except for the features ($F(1,18)= 15.86$, $p < 0.05$) that is the reaction times of the healthy elderly bilinguals had a significant difference in terms of the deciding feature (living versus non-living). There was no significant difference in terms of two paradigms i.e., masked translation and masked repetition priming conditions (F (1, 18) 0.292, $p > 0.05$), no significant difference between the two languages (L1 and L2) ($F (1,18)=0.942$, $p > 0.05$) seen for reaction time measures in healthy elderly bilingual adults.

There was a significant interaction effects obtained between the two priming paradigm (masked translation and masked repetition) conditions and the two languages (L1 and L2) ($F (1,18)=32.86$, $p < 0.05$) and significant interaction effect was seen between the two languages (L1 and L2) and for features (living

versus non-living) ($F(1,18)=32.53$, $p < 0.05$), also with paradigms, language and gender ($F(1,18)=6.64$, $p < 0.05$) for the reaction time measures in healthy elderly bilingual adults. There was no interaction effects observed for paradigms and features ($F(1, 18) = 3.306$, $p > 0.05$) and for paradigms and languages and features ($F(1, 18) = 0.113$, $p > 0.05$) used in the study.

Repeated measure ANOVA was employed to see the significant difference by comparing the three within subject variables, that is, paradigms, languages and features (living v/s non-living) and also the interaction effects among these parameters for the two different age groups and also with respect to males and females separately.

Table 12
Repeated measure ANOVA – Male and Female group

	Gender (Male)		**Gender (Female)**	
Interaction effects	**F**	**Sig.**	**F**	**Sig.**
Paradigms * Language	16.105	.003	20.421	.001
Language * Features	6.062	.036	5.169	.049

There was a significant interaction effects obtained for paradigms and the language used in the study in a male group ($F(1,9)=16.10$, $p < 0.05$), for paradigms and features ($F(1,9)=11.76$, $p < 0.05$), and for languages and features ($F(1,9)=6.602$, $p < 0.05$), used in the study. In the female group, R ANOVA results indicated significant difference in the interaction effects for paradigms and languages ($F(1, 9) = 20.421$, $p < 0.05$), and for languages and features ($F(1, 9) = 5.169$, $p < 0.05$) used in the study.

Further, paired samples t-test was carried out to compare the mean reaction times across masked priming conditions as gender wise.

Table 13
Paired samples t-test: Gender wise (Male and Female)

Conditions	Gender (Male)		Gender (Female)	
	T	Sig. (2-tailed)	t	Sig. (2-tailed)
RML1L2L - RMRL1L	2.751	.022	4.450	.002
RML1L2NL - RMRL1NL	.718	.491	3.812	.004
RML2L1L - RMRL2L	2.744	.023	4.588	.001
RML2L1NL - RMRL2NL	3.577	.006	3.004	.015
RML1L2L - RML2L1L	7.775	.000	5.476	.000
RML1L2NL - RML2L1NL	.452	.662	3.408	.008
RMRL1L - RMRL2L	1.120	.292	3.774	.004
RMRL1NL - RMRL2NL	4.034	.003	3.405	.008

Note: ML1L2- Masked translation in L1-L2 direction, ML2-L1- Masked translation in L2-L1 direction, MR- Masked repetition, L1- Kannada, L2- English, L- Living and NL- Non-living.

When the paired samples t- test was carried out for gender, results revealed significant difference across the two paradigms except for one condition (RML1L2NL - RMRL1NL $t=0.718$, $p > 0.05$) and across the two language directions used in the present study, significant difference was not found for the two pairs (RML1L2NL - RML2L1NL $t=0.452$ $p > 0.05$, RMRL1L - RMRL2L $t=1.120$, $p > 0.05$).

4.1 Accuracy measures

The accuracy measures were analyzed with respect to correct and incorrect responses. The DMDX software saved the correct responses as '+ve' and incorrect responses as '-ve' which were further coded as '1' and '0' respectively. The coded mean values of all correct and incorrect responses were analyzed. Percentage of accuracy in responding to all the conditions varied from 77% to 96%. The error rates were lesser in both of the masked paradigms used in the study.

4.1.1 Accuracy Measures using Non Parametric tests – Wilcoxon Signed Rank Test.

Wilcoxon Signed Rank test was carried out to compare the accuracy measures for two masked conditions and also for two language directions using two related samples.

Table 14

Non parametric test- Wilcoxon signed Rank test for Accuracy measures (overall).

Conditions	Z value	p value
MRL1L – MTL1L2L	0.182	0.856
MRL1NL – MTL1L2NL	0.548	0.584
MRL2L – MTL2L1L	3.139	0.002
MRL2NL – MTL2L1NL	1.281	0.200
MTL2L1L – MTL1L2L	0.920	0.358
MTL2L1NL – MTL1L2NL	0.749	0.454
MRL2L – MRL1L	2.130	0.033
MRL2NL – MRL1NL	1.234	0.217

Results revealed that there was a significant difference for the accuracy measures across two conditions (MRL2L – MTL2L1L) |z|= 3.319 and p= 0.002 and (MRL2L-MRL1L) |z|= 2.310 and p= 0.033. Similarly, Wilcoxon Signed Rank test was performed for two age groups and genders. There was no statistically significant difference obtained across the two age groups and genders considered ($p > 0.05$).

4.3 Discussions

The primary objective of the study was to examine the implicit lexical retrieval in Kannada-English healthy elderly bilingual adults. As tabulated in Table 6, there was a no significant main effect noticed for the age, masked paradigms (masked translation and masked repetition), languages (Kannada and English). However, there was a significant effect noticed for features (Living versus non-living) used in the study. Significant interaction effects were observed between the paradigms and languages and for languages and features considered. The results revealed that living features were retrieved faster than the non-living features. This can be attributed to two things, first, with respect to the handedness phenomenon, all the living categories were coded to "Right control key" and all the subjects who participated were right handed dominant. So this would have resulted in faster reaction time with respect to living category based on the hand dominance. Second, it can be attributed to the semantic features that vary in living and non-living categories (Masson, 1995). The semantic features also depend on the task being performed. In tasks like

semantic categorization as living or non-living, the lexicon is based on the shared features. In contrast, the task involving picture naming, the lexicons are based on the distinctive features. Grondin, Lupker and McRae (2009) conducted an experiment on visual word recognition in young adults and they found that shared features had a facilitatory effect in lexical decision. Although in semantic categorization tasks, the features with less number facilitate in the discrimination among similar features, it has been noted that shared features are assumed to have a stronger representation since they are shared across many concepts. Cree and McRae (2003); Randall, Moss, Rodd, Greer & Tyler (2004) supported and also reported differences in the distribution of semantic features of non-living category in English language. Durate and Robert (2014) found that in picture naming task, living category was better named than the non-living items in healthy older individuals when the shared features were high whereas, in Alziehemers disease patients, there was no difference in performance between the living and non-living when shared features were high. They also support this by giving an explanation that living things are the one which will be acquired first in the life and persist even during ageing. So this might have led to the better naming of living category.

The mean reaction time obtained by the participants varied from 621 ms (SD=102.21) to 995 ms (SD=202.12) in masked translation priming paradigms and from 646 ms (SD=112.22) to 1025 ms (SD=248.12) in masked repetition priming conditions. The maximum reaction time that could have been obtained was at 4000ms. This results suggests that with respect to the reaction

time measures of the lexical retrieval in Kannada-English healthy bilinguals, the response time for the reaction can be reduced to 2500 ms. However, this cannot be generalized as there is no normative data to compare the reaction time obtained, for the population selected, languages considered, type of tasks used and paradigms designed.

The reaction time differences seen between the two masked paradigms are based on the prime duration or awareness of the prime. The visibility of the prime reflects the type of processing taking place in the healthy elderly bilinguals. If the duration of the prime is less then it results in implicit processing which can be achieved through the masked paradigms (Kouider and Dupoux, 2004). In the present study, the duration of prime was kept as 50ms in masked translation and masked repetition conditions. Wang and his colleagues (2014) have reported that shorter the duration of prime approximately 36 to 48ms results in priming for the phonological and morphological information and not the semantic activation of the target in the masked priming conditions. Hence, the present study is also in consonance with the findings of the Wang et al (2014) and suggests that the target identification is not based on the semantic activation. This findings can be attributed to the target features of the language since Kannada is a syllabic language (like Korean). The target word recognition may be dependent on reading proficiency in healthy elderly adults. The word recognition ability is based on the orthographic structure of the language (Leslie and Shannon, 1981). Jackson and McClelland, (1979) suggested that letter recognition helps in further processing of the word.

The first objective was to examine the implicit retrieval mechanism using the masked translation and masked repetition priming in healthy elderly bilingual adults. It was found that lexical retrieval in semantic categorization was faster in masked repetition priming conditions than the masked translation priming conditions. This can be due to the fact that in masked repetition conditions (L1 and L2), there is repeated exposure of the same stimuli in two conditions (prime and target were the same) and hence strategy would have resulted in faster retrieval as there may not be demand for additional strategy for processing. The prime would have opened the lexical entry for the target. Whereas in masked translation priming, there would be language interference and time taken to translate from one language to other would have affected and hence retrieval was slow.

The second objective was to examine the directional effects of masked translation priming on lexical retrieval in L1-L2 and L2-L1 using reaction time and accuracy measures.

The results revealed that healthy elderly bilinguals were able to retrieve faster in the direction of L2-L1 where in the prime was in English and target was in Kannada. Jiang and Forster (2001), have reported that non-dominant language (L2) facilitates recognition of the target in the dominant language (L1) when an ‘‘old-new’’ episodic recognition task was used, but, again, not when lexical decision was used. Finkbeiner, Forster, Nicol, and Nakamura, (2004) studied on Japanese –English bilinguals and suggested that L2-L1 directional priming does not happen in lexical decision task because of insufficient amount of lexical

semantic representation by the L2 prime, whereas in semantic categorization task the information is translated and used to generate the decision with respect to the task category and this restriction results in enhancement of L2 prime. Similar findings have been obtained in the present study with respect to healthy elderly bilingual adults. With respect to masked translation condition L2-L1 direction had a shorter reaction time i.e., prime in L2 and target in L1 and here the prime in L2 has facilitated the target recognition in L1. These findings suggests that prime duration, resulted in facilitating in categorizing the target lexicon. Prime duration in the present study was 50 ms in all the conditions and faster lexical retrieval in L2 to L1 direction can be attributed to the proficiency or use of the language and orthographical features of Kannada language. Kroll & Stewart (1994) suggested that asymmetry in performance reduces as the individual gains high proficiency in L2.

The 50ms prime duration in masked translation in L1-L2 directional priming condition is found to be not efficient, because out of 20 participants 11 participants were able to sense the prime and 3 of the participants out of 11 were able to say what the prime was being presented. Therefore, it is not known the prime duration is adequate enough in describing the implicit processing mechanism, also how much to keep for type of translation direction used has to be explored further. This might be due to the reading proficiency. Automaticity in word reading refers to the simultaneous word reading strategy and it is based on the (visual) structure of the words. The proficient or skilled readers can process the words more automatically and they are less affected by conceptual

information. They are capable of reading words which are present for a brief duration of time. Therefore it is essential to know the rules of orthography of a particular language which is a major factor in the word recognition (Purushothama, 1986). However, the speed of reading words in English is influenced by the factors such as word frequency, class, imageability and/or concreteness. In Kannada Language, the orthography does not influence the speed of reading words in an individual who is skilled or proficient reader. (Karanth, Mathew and Kurien, 2004).

In the present study the visibility of the prime in L1-L2 translation direction condition can be the result of strategic processing of primes thus leading to longer reaction times than the L2-L1 translation direction condition. Even though the participants were not informed regarding the presence of the prime, they reported to sense the primes due to the automaticity and orthographical features of Kannada prime, might have resulted in longer reaction time and further it can be attributed to the strategic processing used by the participants. In addition to that, most of the participants had greater usage of English language over Kannada and was evident with the proficiency measures used in the study. This could have resulted for the difference in performance with respect to the language direction.

The third objective was to examine the effects of masked repetition priming on lexical retrieval in L1 and L2 condition.

The results revealed that participants were able to retrieve and categorize the features as living and non-living faster in L1 (prime and target in

Kannada) conditions. This could be attributed to three reasons. First, it may be due to the greater proficiency and use of Kannada language over English and was evident with the proficiency measures used in the study. Second, the difference in performance can be attributed to feature of the language. In addition to that faster retrieval, it can be attributed to repeated exposure of stimuli in prime and target that could have facilitated along with the proficiency. In support of the present findings, Cristina, Manuel, Carmen & Manuel, (2011) suggested that masked repetition priming was larger in semantic categorization tasks than in lexical decision task, a highly significant masked repetition priming effects were seen for the handwritten prime. Silkes, Dierkes, Kendall (2012) reported on single subject study who had anomia and with 22 sessions of training using masked repetition priming, there was an improvement noticed in word retrieval in naming task.

The results of the present study in healthy elderly bilinguals revealed that masked repetition priming of L1 condition had lower mean reaction time for the lexical retrieval in categorization task (faster), than the masked translation priming of L1-L2 condition. However, it was reverse with respect to L2 of masked repetition priming and L2-L1 of masked translation priming conditions, i.e, masked translation priming of L2-L1 condition had a lower mean reaction time than the masked repetition of L2 condition in categorizing the features as living and non-living. The mean reaction time is found to be low for masked repetition priming of L2 condition (MRL2L) (651ms; SD = 102.81) and the highest mean reaction time obtained in MRL2NL condition (939.72ms; SD =

248.45).Since both the masked paradigms have yielded reaction time within 1100ms and without any significant difference between them. Both have shown that implicit processing mechanism for the lexical retrieval in normal healthy elderly bilinguals for semantic categorization task in two different conditions. Hence, both the masked priming paradigms can be used with different conditions. Overall mean reaction time was better in categorizing the living than non-living features and it was highly significant. Since, the conditions under both masked translation priming and masked repetition priming did not yield any greater difference. Hence, it is not possible to comment which masked priming paradigm is better among the two considered masked paradigms. Further, in masked translation priming with respect to language directions, L2-L1 (prime - English and target – Kannada language) condition had a faster retrieval in categorizing the features as living and non-living and it was significant. With respect to masked repetition priming condition, healthy elderly bilinguals had significantly better performance in L1 (prime – Kannada and target - Kannada) condition than in L2 (prime – English and target - English) condition.

CHAPTER V

SUMMARY AND CONCLUSION

The main objective of the study was to examine the implicit lexical retrieval through masked priming paradigms in normal healthy elderly bilingual adults. Studies on masked priming paradigms have shown that it taps on implicit processing mechanism where in the strategic processing or explicit processing that occurs with conscious awareness of the prime is avoided (Henson, 2003; Merikle, Joordens, &Stolz, 1995; Kiefer, 2002; Kiefer & Spitzer, 2000; Adams & Kiefer, 2012; Kiefer & Martens, 2010; Kiefer & Brendel, 2006; Marcel, 1983; Breitmeyer, 2007). Experimental Studies conducted using masked translation priming have shown difference in translational direction based on tasks used in the study (de Groot & Nas, 1991; Gollan, Forster, & Frost, 1997; Jiang, 1999; Jiang & Forster, 2001; Keatly, Spinks, & De Gelder, 1994; Williams, 1994; Jiang and Forster 2001; Finkbeiner, Forster, Nicol, and Nakamura, 2004). Studies on masked repetition priming paradigms have also shown larger priming effects for the hand written primes in semantic categorization tasks than lexical decision task (Cristina, Manuel, Carmen & Manuel, 2011). Fleischman, Debra, Gabrieli, Reminger, Vaidya and Bennett (1998) studied on object decision priming in Alzheimer's disease and normal elderly adults in two conditions (implicit and explicitly). Findings revealed that normal healthy elderly participants performed significantly faster and were more accurate in categorising the real and non-real objects and in case of Alzheimer's disease (AD) participants, the strategic or the explicit processing was impaired.

However, in terms of real objects results suggested that AD patients had an intact repetition priming.

However, many studies have been carried out in the western context and hence, there was a dearth of research in the Indian context. Lexico-semantic representations for the lexical retrieval in aging population are not clear. Priming experiments on healthy aging and in Alziehemer's disease patients have shown impairment in explicit memory in aging (Kausler, 1994; Light et al., 2000; Spaan et al., 2003) and profoundly impaired in Alziehemer's disease (Carlesimo and Oscar Berman, 1992; Spaan et al., 2003). Most of these studies were on healthy bilingual adults and the present study aimed to investigate the implicit lexical retrieval mechanism through masked priming paradigms in normal healthy elderly Kannada-English bilingual adults.

Twenty Kannada-English normal healthy elderly bilingual adults in the age range of 60 to 70 years participated in the study. Participants were divided into two groups with an age interval of 5 years each (61-65 in Group1, 66-70 in Group2). Each group had 10 participants with equal distribution of gender (M=5; F=5). All the participants were native speakers of Kannada language and learnt English language as a medium of instruction. Participants were selected based on inclusion criteria i.e. all participants were screened for visual acuity using Snellen's chart (Snellen, 1862), Language proficiency using Language Experience Proficiency Questionnaire (Ramya & Goswami, 2009) and they were also screened for cognitive status using Mini Mental Status Examination (MMSE) Folstein, Folstein and Mc Hugh (1975). Those who had perfect native

like proficiency in Kannada language and fair to good proficiency in English and scored equal to 25 or above 25 in MMSE served as participants. Cross sectional and counter balanced design was employed. Two masked priming paradigms used in the present study are masked translation and masked repetition priming. Four word lists were prepared consisting of 20 pairs of stimuli in each list with both living and non-living as features in equal number and words were taken from the ARF 3.47 project (Prema, 2010- Development of a test for Assessment of language Proficiency in Bilingual Adults through Lexical Priming. All India Institute of Speech and Hearing, Mysore AIISH). The Stimuli were randomly presented on a computer screen using DMDX software (Forster and Forster 2003). All the participants were given practice trials with 4 word pairs in all the four conditions to familiarize the participants with the task, then the real word lists with four different conditions were presented i.e., masked translation from L1- L2 direction, L2-L1 direction and masked repetition in L1 and L2 conditions. The participants were instructed to categorize the target item based on living or non-living features. They were asked to press 'right' control key if the target belongs to living category and press 'left' control key if the target word belongs non-living category.

For each of the paradigm, reaction time scores was calculated separately and later combined scores of all the paradigms were also calculated. All the scores obtained were tabulated and subjected to SPSS software version IBM 21 for statistical analysis.

The data was subjected to descriptive statistics and based on the normality criteria, parametric and non-parametric tests were carried out.

The results of the present study in healthy elderly bilinguals revealed that masked repetition priming of L1 condition had lower mean reaction time for the lexical retrieval in categorization task (faster), than the masked translation priming of L1-L2 condition. However, it was reverse with respect to L2 of masked repetition priming and L2-L1 of masked translation priming conditions, i.e, masked translation priming of L2-L1 condition had a lower mean reaction time than the masked repetition of L2 condition in categorizing the features as living and non-living. Overall the mean reaction time was found to be low for masked translation priming of L2-L1 condition (MTL2L1L) (621ms; SD = 102.81) and the highest mean reaction time obtained for masked repetition priming in MRL2NL condition (1025 ms SD=248.12). Since, the conditions under both masked translation priming and masked repetition priming did not yield any significant difference, it is not possible to comment which masked priming paradigm is better among the two considered masked paradigms. Overall mean reaction time was better in categorizing the living than non-living features and it was highly significant.

Further, in masked translation priming with respect to language directions, L2-L1 (prime - English and target – Kannada language) condition had a faster retrieval in categorizing the features as living and non-living and it was significant and it was attributed to visibility of the prime in L1-L2 translation direction condition can be the result of strategic processing of primes

thus leading to longer reaction times than the L2-L1 translation direction condition. The present study is in consonance with Kroll& Stewart (1994), Jiang and Forster (2001), Finkbeiner, Forster, Nicol, and Nakamura, (2004) studies.

In masked repetition priming condition healthy elderly bilinguals had significantly better performance in L1 (prime – Kannada and target - Kannada) condition than in L2 (prime – English and target - English) and it was in consonance with the experiment carried out by Cristina, Manuel, Carmen & Manuel, (2011).

5.1 Conclusions

To conclude, the results of the present study revealed that there was a difference within the masked translation priming conditions with respect to the translational direction. The prime being observed in L2-L1 translation direction in semantic categorization task suggests that there is an asymmetry in translation priming and which can be attributed the lexical-semantic links explained by the sense model. According to this model feature serves as a filter thus it eliminates the representational asymmetry. This was also attributed to visibility of the prime and which depends on the features present in the language.

In masked repetition priming, the priming effects were observed for the L1 condition than the L2 and this was attributed to repeated exposure of the same stimuli in 2 conditions. In addition to that, language proficiency and use of language was greater in L1 which might have contributed to the findings obtained.

5.2 Clinical Implications of the study

Understanding the contribution of implicit processing and differential priming effects observed within the masked priming paradigms in normal healthy elderly bilinguals have provided information on which language features has to be considered to attribute for the priming to treat naming difficulties in bilinguals with native like proficiency in Kannada and fair to good proficiency in English. According to the results obtained, we can start with masked translation priming in L2-L1 direction and when using masked repetition priming, L1 condition can be started to treat the naming difficulties.

5.3 Limitations of the study

i) Increased sample size could have been attributed to the better confirmed results.

ii) Word length and frequency was not considered.

iii) Along with MMSE, other cognitive tests was not administered to differentiate between the normal aging and mild cognitive impairment.

5.4 Future Directions

1) This study can be done considering the word length and frequency effect
2) Masked priming paradigms can be used to investigate the implicit lexical retrieval in other populations like persons with aphasia or in pathological aging and in different age groups.

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Appendix-1 Presentation of the stimuli in four different conditions

Conditions	Hash mark (500 ms)	Prime (50 ms)		Target (500 ms)
Masked Translation in L1-L2	###	ಕೋತಿ	Inter Stimulus	MONKEY
Masked Translation in L2-L1	###	Monkey		ಕೋತಿ
Masked Repetition in L1	###	ಕೋತಿ	Interval 50 ms	ಕೋತಿ

Masked Repetition in L2	###	Monkey		MONKEY

Appendix II Stimulus List

LIST 1

Translation Equivalents (Kannada to English)	
ಬೆಕ್ಕು	**CAT**
ಪುಸ್ತಕ	**BOOK**
ಮರ	**TREE**
ಸೂಜಿ	**NEEDLE**
ಕೋಳಿ	**HEN**
ಅಕ್ಕಿ	**RICE**
ನರಿ	**FOX**
ಬೆಳ್ಳಿ	**SILVER**
ಕಾಗೆ	**CROW**
ಕೊಠಡಿ	**ROOM**
ಮೇಕೆ	**SHEEP**
ಒಂಟೆ	**CAMEL**
ಶಾಲೆ	**SCHOOL**
ಮಗು	**CHILD**
ಹಣ	**MONEY**
ಗೂಬೆ	**OWL**
ನವಿಲು	**PEACOCK**
ಹಂಸ	**SWAN**
ಕತ್ತರಿ	**SCISSORS**

LIST 2

Translation Equivalents (English to Kannada)	
Knife	ಚಾಕು
Monkey	ಕೋತಿ
Crocodile	ಮೊಸಳೆ
Plate	ತಟ್ಟೆ
Scorpion	ಚೇಳು
Sand	ಮರಳು
Peacock	ನವಿಲು
Oil	ಎಣ್ಣೆ
Snake	ಹಾವು
Ornament	ಒಡವೆ
Bird	ಹಕ್ಕಿ
weapon	ಅಸ್ತ್ರ
child	ಮಗು
chariot	ರಥ
wood	ಸೌದೆ
swan	ಹಂಸ
Cave	ಗುಹೆ
flower	ಪುಷ್ಪ
satellite	ಉಪಗ್ರಹ

LIST 3

Repetition Priming of L1 (Kannada to Kannada)	
ಬೆಕ್ಕು	ಬೆಕ್ಕು
ಪುಸ್ತಕ	ಪುಸ್ತಕ
ನರಿ	ನರಿ
ಮರ	ಮರ
ಸೂಜಿ	ಸೂಜಿ
ಕೋಳಿ	ಕೋಳಿ
ಅಕ್ಕಿ	ಅಕ್ಕಿ
ಕಾಗೆ	ಕಾಗೆ
ಮೇಕೆ	ಮೇಕೆ
ಬೆಳ್ಳಿ	ಬೆಳ್ಳಿ
ಕೊಠಡಿ	ಕೊಠಡಿ
ಒಂಟೆ	ಒಂಟೆ
ಶಾಲೆ	ಶಾಲೆ
ಮಗು	ಮಗು
ಹಣ	ಹಣ
ಗೂಬೆ	ಗೂಬೆ
ಘಂಟೆ	ಘಂಟೆ
ಬಲೆ	ಬಲೆ
ನವಿಲು	ನವಿಲು
ಕತ್ತರಿ	ಕತ್ತರಿ

LIST 4

Repetition Priming of L2 (English to English)	
oil	**OIL**
monkey	**MONKEY**
crocodile	**CROCODILE**
plate	**PLATE**
scorpion	**SCORPION**
snake	**SNAKE**
peacock	**PEACOCK**
knife	**KNIFE**
bird	**BIRD**
ornament	**ORNAMENT**
swan	**SWAN**
weapon	**WEAPON**
child	**CHILD**
cave	**CAVE**
satellite	**SATELLITE**
chariot	**CHARIOT**
sand	**SAND**
flower	**FLOWER**
groom	**GROOM**