WORD RECOGNITION IN KANNADA-ENGLISH BILINGUALS

Sarga Jose

Register No.: 15SLP025

A Dissertation Submitted in Part Fulfillment for the

Degree of Masters of Science

(Speech-Language Pathology)

University of Mysore, Mysuru

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI, MYSURU – 570006

May, 2017

CERTIFICATE

This is to certify that this dissertation entitled **"Word Recognition in Kannada-English Bilinguals"** is a bonafide work submitted in part fulfilment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 15SLP016. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru
May, 2017

Prof. S.R. Savithri
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysuru-570006

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This is to certify that this dissertation entitled **"Word Recognition in Kannada-English Bilinguals"** has been prepared under my supervision and guidance. It is also being certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru
May, 2017

Guide
Dr.K.S. Prema
Professor of Language Pathology
Dept of Speech-Language Sciences
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

DECLARATION

This is to certify that this dissertation entitled **"Word Recognition in Kannada-English Bilinguals"** is the result of my own study under the guidance of Dr.K.S.Prema, Professor of Language Pathology, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru **Registration No.: 15SLP025**

May, 2017

Dedicated to my appa….

ACKNOWLEDGEMENT

I would first like to thank the god almighty for being with me all the time and keeping me healthy till the end of the dissertation

Prof K S Prema, our beloved Prema ma'am, a mere thanksgiving would not be sufficient to extend my gratitude towards you maam. Thank you mam for all your support and guidance in every phase of this work admist your busy schedule.

Thank you Dr. Savithri S.R. ma'am...for providing me the opportunity to carry out the research work.

Thank you Raghavendra Sir for your timely support and developing the online program and helping out with all the problems that were faced during the validation process.

Santhosh Sir,,,thank you for easing out with the statistical analysis and clearing all doubts.

NiharikaDi,,,you were a supporting pillar throughout the work. You are one of the reasons for the successful completion of this dissertation. Thank you di for all your timely support. A whole lot of gratitude for patiently sitting with me during the entire writing process.

Amma...My powerhouse of confidence. Thank you for being with me at the toughest times. Your smile and your enthusiasm is enough for me to boost my spirits whenever I feel low.

Mathukutty! I am fortunate to have a brother like you! Your maturity, sensitivity and tolerance are worth to be appreciated. Thank you for your unconditional support.

I would like to thank Nithya for helping me.

When you absolutely cannot find any solutions for your trouble, and gets lost in to an absolutely perplexed state, A true friend is all what is required. Ani..you are one among them and words can't explain how blessed I am to have you as my friend. Thank you for tolerating my worries and complaints.

A biiig thanks to my "conflict resolutionist"..Aanakutty (Anand), you never fail to be by my side and help me sort out things at the most helpless moments. THANK YOU!

Vinay- the technocrat! When I was struggling with my analysis it was you who help me update my technological innovations! Thank you so much for helping me out even when you had a really tough schedule ☺

Thank you all my dear chechis akhila chechi(especially for your lap top) Radhikachechi,Shebachechi,Akshathachechi,Vidhyachechi,SwathychechiAnd my dear Jim chetta for your support and motivation. You guys are the BEST seniors ever!!!

Thank you Anitha Chechi ,Deepthy chechi and Anjana Ma'am for your moral support throughout the period of this dissertation.

Sneha mol..thankyou so much for the technical support provided ☺☺

I would like to extend my sincere gratitude to all my clients in special clinics for having the faith in me and making me forget all the dissertation tensions during the clinical hours.

I would also like to thank all my juniors who participated in this study. Sumanth.. I know the effort that you have put for helping me hunt the "guinea pigs", Thank you so much!

I would also like to extend my gratitude to all the staffs in the library for helping me out relentlessly by providing all the full length articles and books.

I am lucky to have such amazing people around me, helping me out in the most subtle manner. Anu and Anju..my master buddies.. thankyou so much for being there with me every single time I needed some help. For anything and everything one shout is what all that was required ☺

There are times at which you gain support through the most indirect way possible. Priyanka di.. I need to thank you for engaging the sessions .The time gained through that is how i finished several minute works of mine.

Jesnu..Thanks for the help provided when I was thrashing about at the 11th hour. Divyashree..my posting partner, thank you for all the moral support and consoling sessions provided.

Shankar.. I appreciate and acknowledge the time that you have spent for my data collection as a subject though you were tightly packed with work.

To all the "malayalees" in the hub! There is no need to say thankyou in special to all of you. We all know how we are. Veepee, Naini, Meenu, Varsha, Jasi, Meher, Kirti, Anoopa, Jeena, Bincy, Devika, Anju B, Margaret thank you all for making my AIISH life so colourful.

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CHAPTER 1

Introduction

Communication is the act of transferring information from one person to another. The process of communication which involves exchange of information is a very complex phenomenon. There are many modalities through which communication can happen. Communication can be done through verbal mode and non-verbal mode. Language is the primary mode of verbal communication in human species. The desired outcome of any communication process is to understand the message. The initial stage of understanding the verbal output of a spoken word or a written word is recognition of the words. The ability to recognize the words in order to understand the meaning of language spoken or written refers to spoken word recognition and visual word recognition respectively. These complex phenomena are well explained using many theories and models by researchers in the past.

Models of spoken word recognition have come up as adaptations of models used in visual word recognition (Forster, 1989; Morton, 1970). However, important changes need to be incorporated to account for the uniqueness of speech as a temporal phenomenon. The difficulty of the translation problem in converting visual word recognition models to spoken word recognition models can be illustrated by comparing spoken language to written language. The most obvious difference is that speech is distributed in time, whereas writing is distributed in space and written language is physically invariant, it does not change with time .Spoken language in contrast, is highly variable; each time a speaker produces a sound, a different acoustic form is generated. Another difference between spoken and written language deals with linearity of the message spoken or written. Characters on a printed page have discrete borders and are linearly arrayed so that successive sounds are represented by strings of letters. Speech fails to demonstrate such an arrangement between the linguistic symbols used to transcribe an utterance and the speech waveform. Another difference is that letters and words are separated (segmentation) on the printed page. But that kind of physical segmentation is rarely possible in spoken language. Therefore, visual word recognition is easier to understand than spoken word recognition.

1.1 Visual word recognition

Visual word recognition is the basic process in reading; that is the stage prior to meaning assignment. The context of word recognition refers to matching a word's orthographic/or phonological description stored in long term memory (for eg: word=w+o+r+d) to information generated in on-line about which letters are presented in the word which is written. Readers use the visual representations that are provided by print to recover the phonological and linguistic structure of the message. Earlier studies have compared the readers' ability to recognize words and non-words/pseudo words and have shown that readers can recognize true words easily than non-words or pseudo words. The findings indicated the presence of different storage for words and non-words. The storage of words is generally referred to as 'Mental lexicon'. Mental lexicon is considered as the mental dictionary where the words are stored. There is a long standing debate related to the representation of mental lexicon, as whether the mental lexicon is organized by morphemes or by words. More recent studies suggest two routes for word recognition, one based on morphological analysis and the other based on whole-word storage. It is necessary to understand the process of word recognition with an access to mental lexicon.

In dual-route view, morphologically complex words are simultaneously analyzed as whole words and in terms of morphemes. A model given by Wurm

(1997); Wurm and Ross (2001) explain the way in which the mental lexicon maintains a representation for combination of morphemes in different ways. A potential word root is checked against a list of free roots that have combined before in the past with the prefix which is given.

Despite the differing views on word recognition, considerable disagreement concerning the precise way in which meaning is accessed during reading persists. The disagreement among psychologists lies around the central function of the cognitive reading system to extract meaning from visual symbols (i.e., written words). For example, the role of phonology and orthography in semantic access continues to be the focus of a great deal of controversy within the reading literature (Frost, 1998). Some theories hold that semantic access is mediated by phonology (Frost, 1998; Lukatela& Turkey, 1994a, 1994b; Van Orden, Pennington & Stone, 1990), whereas other theories hold that phonological computation is unnecessary and that semantic information can be recovered directly from orthography (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Forster, 1976).

Although it is clear that phonology and other aspects of language are retrieved in reading, there are a number of questions about how linguistic structure is derived from print. One idea, which is embodied in dual-route theories such as that of Coltheart et al (2001), is that two different routes are available for converting orthographic representations to phonological representations. A lexical route is used to look up the phonological forms of known words in the mental lexicon; this procedure yields correct pronunciations for exception words such as *love*. A non-lexical route accounts for the productivity of reading. It generates pronunciations for novel letter strings (e.g., *pove*) as well as for regular words (e.g., *stove*) on the basis of smaller units. This latter route gives incorrect pronunciations for exception words, so that these words may be pronounced slowly or erroneously (e.g., *love* said as /lov/) in speeded word naming tasks (e.g., Glushko, 1979). In contrast, connectionist theories claim that a single set of connections from orthography to phonology can account for performance on both regular words and exception words .(e.g., Plaut et al., 1996; Seidenberg & McClelland, 1989). All the above said models have explained the word recognition considering the mental lexicon of monolinguals. The nature of mental lexicon in bilingual and multilingual population might serve interesting.

1.2 Visual word recognition in bilinguals

According to ASHA (2004) bilingualism has been defined as the use of at least two languages by an individual. Bilinguals are able to communicate in either of their two languages without experiencing constant interference from the inactive language. But then, when a bilingual learns something via one language, there appears to be access to that knowledge via the other language. Although, it is well known that despite the language system being separate in practice, some information is often shared. So there arises a question as to whether the languages are represented separately as independent storage in memory or all languages are represented in a shared, interdependent semantic module. These questions have important implications for an understanding of bilingual behavior and for more general models of memory and representation of mental lexicon in bilinguals. Two early models were proposed by Potter, So, Von Eckardt, and Feldman (1984) to understand the nature of bilingual's semantic memory. In the Word Association Model, lexical representations from language 1 are directly linked to the conceptual system whereas, the words of language 2 are connected only to language 1 and have no direct connections to the conceptual system. An alternate model called the Concept Mediation Model suggests that representations of the two languages are not directly connected. Instead the two language representations operate as separate systems that each directly connect to a modal conceptual system.

Factors such as age of acquisition of language, the language structure, use of the languages in daily routine and several others contribute to the quantitative as well as qualitative differences between monolingual and bilingual word recognition. Support for quantitative difference comes from the increasing number of studies that suggest that bilingual word recognition is initially “nonselective,” which means that a language input activates word representation in both of the bilingual’s language subsystems the contextually appropriate as well as the contextually inappropriate (De Groot, Delmaar, & Lupker, 2000) because the two lexical subsystems of a bilingual together store more word representation than a monolingual lexicon. Initial non selectivity refers that upon presentation of a word there will generally be more lexical competition in a bilingual than in a monolingual. Qualitative differences are assumed by a well-known model of lexical access in bilinguals, the Bilingual Interactive Activation (BIA) model (Dijkstra & Van Heuven, 1998). Study done by Prarthana, Rajashekar, and Krishnan (2011) provided evidences for the language non-specific view of bilingual lexical activation by extending the phoneme monitoring task into two orthographically different languages (Kannada and English). In addition to this, the study also shed light into the possible role of orthography in phoneme monitoring task especially in orthographically distinct languages.

Visual word recognition in bilinguals can be investigated through psycholinguistic and neurolinguistic techniques. Commonly used and easier psycholinguistic methods are reaction time experiments (lexical decision and priming). In the lexical decision (LD) task, the participant makes a speeded manual decision to a letter string on the computer screen that whether it is a word or non-word. This task can be modified depending on the stimuli used, population under study and also objective of the study. Studies on language processing in bilinguals, experimental paradigms of semantic and translation priming are widely used to explore the structure of bilingual lexicon. Priming paradigms facilitate study of automatic processing that is crucial to an understanding of language processing in bilinguals. In translation priming, prime word will be presented in one language (L1/L2), and the target word will be presented in the other language (L1/L2), which will be the translation of the prime word. For example: If prime word is /water/ (English), target word will be /niru/ (Kannada).In translational priming, presentation of a prime words will automatically causes lexical entry (Forster and Davis,1984) to be activated so that less target processing has to be done before a response is made [short SOAs (Stimulus Onset Asynchrony: The amount of time between the beginning of the prime and the beginning of the target)].

1.3 Need for the study

To understand the mental lexicon of any individual, visual word recognition skills plays a major role. Visual word recognition in turn depends on the languages which are represented in the mental lexicon of an individual. Word recognition is influenced by the nature of language structure as well as the number of languages used by a person. Other factors influencing word recognition are frequency effect, proficiency in the language etc. Representation of mental lexicon in bilingual's brain is always a question of debate, whether it is a shared lexicon or separate lexicon. On the other hand, visual word recognition is further influenced by the orthographic structure of a language. India being a culturally diverse country is a land for many languages. The structure of Indian languages varies from the languages in which the research exists. Hence, there arises the need for studying the mental lexicon of Indian bilinguals. The present study attempts to examine the mental lexicon in Indian bilinguals through visual word recognition tasks.

Kannada, one of the widely spoken languages in South India is semi-syllabic in nature. The variation in the orthographic nature demands investigation of the nature of mental lexicon in Kannada-English bilinguals. The present study addresses the issue of visual word recognition in Kannada-English bilinguals through lexical decision and judgment tasks by employing a translation priming paradigm.

1.2 Aim of the study

The aim of the study was to examine the nature of visual word recognition in Kannada-English bilinguals through lexical decision and lexical judgment tasks of translated words.

1.3 Objectives of the study

1) To compare the performance of bilinguals on visual word recognition between lexical decision and lexical judgment tasks.

2) To examine the reaction time and accuracy for visual word recognition in lexical decision and judgment in Kannada-English bilinguals.

CHAPTER 2

Review of literature

Communication is the process of exchange of information between each other. Communication can be done through so many ways like verbal mode and non-verbal mode. Ultimate goal of communication is to understand the information which the communication partner has intended. Understanding of information can be done through visual mode and spoken mode. These are called as visual word recognition and spoken word recognition. Spoken word recognition is not linear and it is variant across time, but visual word recognition is not variant and it is linear. Visual word recognition is the basic process of reading.

One of the most basic process in reading involves the rapid and effortless assigning of the appropriate meaning to a series of letter threads arranged. The term word recognition will be the initial stage of this assignment process which is prior to meaning retrieval. The earliest theories (Cattel, 1886) state that words are recognized as a whole on the basis of their shapes and not in terms of their component letters. But modern theories which are based on behavioural (Bowers, 2000) and neuropsychological (Coltheart, 1981; Tainturier & Rapp, 2001) studies states that visual word recognition is independent of surface properties such as case, position, font, colour, and size.

The fast and effortless assignment of the exact meaning to a series of letters stands as the foremost stage in reading. The term word recognition will be the initial stage of this assignment process which is prior to meaning retrieval. In this relation word recognition means matching a word's orthographic/or phonological description stored in long term memory (for eg: word=w+o+r+d) to information generated in on-line about which letters are presented in the word the eye is currently fixating (in limiting the analysis to alphabetic languages it is assumed that letters are critical units subtending the visual word recognition process).Readers use the visual representations that are provided by print to analyse and recover the phonological and linguistic structure of the message. Readers often access phonology even when they read silently and even when reliance on phonology would tend to affect their performance.

Tracing the visual stimulus on to abstract letter representation enables skilled readers to recognize words rapidly, even though they may appear in surface contexts (Eg: Hand writing, typeface) of which the reader has no experience. Hence, visual word recognition forms an important aspect of reading. Even though skilled readers are able to recognize visually presented words rapidly and easily, the processes that map orthography onto phonology and semantics are far from straight forward.

2.1 Visual word recognition

Visual word recognition was typically thought of as the process of going from a printed string of letters to the selection of a single item stored in lexical memory in the form of word. Lexical memory, or commonly referred as the "mental lexicon," is a mental dictionary containing entries for all the words a reader knows. Thus, word recognition earlier was essentially synonymous with the terms "lexical access" or "lexical selection". Words were thought to be represented as lexical entries in the memory of an individual. All these earlier thoughts on word/ visual word recognition were scrutinized by researchers which led to the conceptualization of models.

2.1.1 Models of visual word recognition

Most of the early models of word recognition (e.g., Gough, 1972; Massaro, 1975; Morton, 1969; Smith & Spoehr, 1974; Theios & Muise, 1977) relied upon two assumptions. First, the human information processing system involves a series of processing stages that work in a serial, non overlapping fashion. Information flows only through one way, that is, forward, through the systems and, further, each stage is essentially gets completed before the next begins. The notion is that a stage is ready to pass information on to the next stage only when the activation at the prior stage reaches a threshold. In contrast, models proposing that information passes between stages as soon as information at one stage begins to be activated are referred to as "cascaded" (McClelland, 1979). The second assumption was that the word recognition system is an autonomous system, that is, it works only with the information stored within it, in particular, the information that can be referred to as lexical information (Forster, 1981; Theios & Muise, 1977). These models proposed an initial perceptually based process that leads to the activation of sub lexical units (letter units).The activation of these sub lexical units allows the formation of prelexical code. This code activates those word (lexical) units that are more or less consistent with it. Ultimately, one of these units is selected or accessed and meaning gets activated/ processed. The models of visual word recognition are broadly classified as search and activation models. Search models assume threshold, autonomous processing in which readers recognize a word by comparing a prelexical code against a set of lexical codes until a match is obtained. The search is not through all of lexical memory but rather, some process designates a section of lexical memory as the optimal search area and the search is confined there. The bin model and activation-verification model are the best exemplars for search models. Activation models represent the other end of the continuum from the search models in terms of cascaded and autonomous processing. The well known activation models include the interactive activation model and parallel distributed processing model.

According to Forster's (1976) bin model, the lexical system involves three peripheral access files and a master file. Each contains information about all the words in the mental lexicon. The three peripheral files are orthographically, phonologically and semantically based and each of these serves as a means of getting to word in the master file where all the information about the word is contained. It is relevant to visual word recognition to focus on the orthographic file in which each word in our lexicon contains an entry. In each entry in the orthographic file are two things, an orthographic access code, which is a description of the orthographic properties of the word, and a pointer to the location for that word in the master file. When a word is viewed, a perceptual process turns that word into a prelexical code that forms orthographic access codes. The orthographic file is then searched by comparing the prelexical code with the orthographic access codes. This search is constrained to a section of the orthographic file which is organized into bins that contain similar orthographic access codes. So, for example, the words CAT and CAN would probably be in the same bin. In essence, the search is constrained to the bin that is most likely to contain the word being viewed. If the search through the designated bin turns up a close match with one of the entries, the location of this entry is noted while the search continues, looking for other close matches. If a match is close enough, the entry is opened and the pointer to the master file is used to access the word's entry in that file. This process engages a second analysis, referred to as "post-access check," which compares the properties of the stimulus with the properties of the word in the master file. If this comparison is successful, the word has been successfully recognized.

In contrast to Forster's model, Paap, Johansen, Chun, and Vonnahme (1982; 2000) proposed the activation-verification model which assumes cascaded processing in visual word recognition. In this model, letter units are activated first and then word units are activated in a serial, but cascaded manner (information passes through the system before initial processing is complete). Activity at the letter level continuously feeds into the lexicon with the activation of respective lexical unit being a function of the activity levels of that word's constituent letters. It is the activity levels in the lexicon that determine which set of words which are selected for further processing. The nature of further processing is crucially dependent on whether the reader has been able to establish a "refined perceptual representation of the word" (Paap et al., 1982, p. 574), which usually happens in normal reading. In this case, the set of selected words is serially verified against the perceptual representation. If there is a sufficient match between a word and the perceptual representation at any point, the word is accepted and the verification process is terminated. Thus, a probabilistic selection is made from among the selected words based on the activation levels of those words.

Further, the models were refined which formed the core for a number of other models in the literature. The interactive activation model (McClelland & Rumelhart, 1981) was specifically intended to be a model that would explain the effects of higher-level information on lower-level processing, in particular, the word superiority effect. In the model, there are three levels of representation: feature, letter, and word. When processing begins, there is a continuous flow of activation from feature-level representations to letter-level representations to word-level representations, as well as from word-level representations back to lower level representations (feedback activation). There is also a flow of inhibition between representations at the same level. Lexical selection is achieved when the activation in a lexical representation exceeds a threshold. These models rely on the assumption that the core phenomenon in word recognition is selecting and accessing (isolating) the lexical unit. More recently, this notion of lexical unit is substituted with a lexical system which are sets of distributed, sub symbolic codes representing the attributes of the words in the lexicon. The word recognition process is the process of activating the appropriate sets of these codes. The models are referred to as parallel distributed processing (PDP) models. Seidenberg and McClelland (1989) proposed PDP models with a word recognition system which involves three types of mental representations (orthographic, phonological and semantic representations). Units of each type are assumed to be connected to units of the other types, producing the triangle representation. When presented with a word, the units at all levels begin to activate (and inhibit) each other, resulting in a pattern of activation across all the units. These activation patterns, which initially will be quite inaccurate, are compared with the correct patterns and then weights between units are adjusted in order to make processing more accurate the next time. This process continues with each new exposure to the word. As a result, over time, activation in one set of units comes to produce the appropriate activation in the units in the other pools (e.g., orthographic processing of the visually presented word CAT allows the activation of the phonological units for the phoneme sequence [kat]).

To explicitly explain the phenomena of visual word recognition, any model should address replicability criteria and its likelihood to reflect the architecture of visual word recognition system. However, the efficacy of model varies with respect to the paradigm employed in the experiments. To name a few: word superiority effect, word frequency effect, ambiguity effect, and priming effect. Word superiority effects refer to the accurate processing of lower level units (letters) when presented words than non-words (Reicher, 1969; Wheeler, 1970). In case of word frequency effect, frequently encountered words are recognized rapidly than infrequent words (Becker, 1976; Forster & Chambers, 1973; Monsell, 1991; Monsell, Doyle, & Haggard, 1989). The priming effects are usually seen on presenting a related prime than an unrelated prime prior to the target word (Lupker, 1984; Shelton & Martin, 1992). Neighborhood effects have shown variable findings (Grainger, 1990; Grainger & Jacobs, 1996; Grainger, O'Regan, Jacobs, & Segui, 1989). All these effects are found to be task dependent. The effects of word superiority, word frequency, ambiguity and priming are usually seen in lexical decision tasks. On the other hand, naming tasks would have the effects of regularity and length of the words. There are also effects based on the response to non words in lexical decision task such as nonword legality effect (Rubenstein, Lewis, & Rubenstein, 1971; Stanners & Forbach, 1973), the pseudo homophone effect (Coltheart et al., 1977; Dennis, Besner, & Davelaar, 1985), and the nonword neighborhood size effect (Coltheart et al., 1977). The various models discussed above have their strengths and weaknesses based on their ability to account for the basic phenomena of visual word recognition. Since the early 1970s, several studies have been made in terms of understanding the visual word recognition process. A major trend that has emerged during this time period has been uplift towards word recognition models that assume considerable interactivity among the various types of lexical and semantic structures.

2.1.2 Interaction with semantics and syntax

One question, which relates to the trade-off in visual word recognition, is whether the mental lexicon is organized by morphemes or by words. Factors involved in retrieving information from the lexicon are semantic priming, word frequency, morphological structures, lexical ambiguity and retention of lexical items. More recent studies says that there are actually two routes to recognition for polymorphemic words, one based on morphological analysis and the other based on whole-word storage.In one instantiation of this dual-route view, morphologically complex words are simultaneously analyzed as whole words and in terms of morphemes. In the model of Wurm, 1997; Wurm and Ross, 2001, the system maintains a representation of which morphemes can combine, and in what ways. A recognized or given word root is checked against a list of free roots that have combined before in the past with the prefix in question.

In another instantiation of the dual-route view, some morphologically complex words are decomposed and others are not. There is an argument among psychologists that the central function of the cognitive reading system is to extract meaning from visual symbols (i.e., written words). There is, however, considerable disagreement concerning the precise way in which meaning is accessed during reading. For example, the role of phonology and orthography in semantic access continues to be the focus of a great deal of controversy within the reading literature (see, e.g., Frost, 1998). Some theories hold that semantic access is mediated by phonology (e.g., Frost, 1995, 1998; Lukatela & Turkey, 1994a, 1994b; Van Orden, Pennington, & Stone, 1990), whereas other theories hold that phonological computation is unnecessary and that semantic information can be recovered directly from orthography (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Forster, 1976).

During visual word recognition, the interaction between semantics and syntax (specifically morphosyntax) are directly related to the interaction between phonology and orthography. The mechanisms of phonology-orthography interaction are associated with the structure of the language under study. The orthographical representation of the word depends on the characteristics of the language which in turn influences the word recognition abilities. In case of monolinguals, only one language needs to be accessed and recognized. On the other hand, bilinguals have to select, access, and recognize words in two languages as per the task demands. Evidence so far suggests that the hierarchical structure as well as the interactions across the different levels of representations is plausible for both monolingual and bilingual visual word recognition, at least for alphabetic languages and for bilinguals whose two languages share the same alphabet. Research in bilingual population is gradually expanding because the number of people speaking two or more than two languages is outgrowing rapidly compared to people who speak one language (monolinguals) across the globe.

2.2 Bilingual visual word recognition

Bilingualism and/or multilingualism is considered more a norm than an exceptional phenomenon in today's world. Bilingualism is considered as the equal mastery of two languages. The native language is referred to as first language (L1) and the language learnt later as second language (L2). Language representation in human brain is usually studied by psycholinguists. With an increase in the bilingual population across the world, the representation and processing of L1 and L2 in bilingual brain stands as the main focus of research in psycholinguistics. The representation of L1 and L2 in the bilingual brain has taken variable views. Information perceived in any language gets stored in the lexical memory either through auditory or visual modality. The storage can be through spoken or visual word recognition; however, the representation and processing also differs with respect to the modality of the input.

2.2.1 Mental lexicon in bilinguals

The nature and type of mental lexicon in bilinguals was always a big dispute between researchers. Even though if the language system is separate in practice, still they share some information. This arise a question whether the languages are represented separately as independent modules in memory or all languages are represented in a shared, interdependent semantic module. These questions should be addressed properly for the understanding of bilingual behavior and for more general models of memory and representation. An attempt to address these issues has been made by the following models.

(a) The common-store hypothesis or interdependence hypothesis

This hypothesis proposes that there is just one lexicon and one semantic memory system consisting of words from both languages and stored in it (Mc Cormack, 1977).In daily life every highly proficient bilinguals are able to translate languages very easily, voluntarily and rapidly. This can be considered as a support for this hypothesis. The evidence from the study of Grainger, 1993 suggests that non-target lexical system is always active to a certain extent so that language interference is happening in the most monolingual of processing situations.

(b) The separate store hypothesis or independence hypothesis

It states that there are distinct storages for each language so that the language processing in one language does not automatically affect the language processing in the other language (Kolers, 1963). This hypothesis has more evidences from laboratories.

(c) The hierarchical hypothesis

This hypothesis says that none of the two hypotheses, that is the common store hypothesis and separate store hypothesis does not describe bilingual lexical representation because various experimental tasks emphasize different processes (Gerard & Scarborough, 1989). In general, findings with tasks that emphasize surface attributes support the independence or separate-store hypothesis while findings with tasks that emphasize semantic or conceptual attributes support the interdependence or common-store hypothesis (Durgungolu & Roediger, 1987).

In order to further substantiate the proposed hypothesis, models of lexical organization have been proposed by researchers and are described below.

2.2.1.1 Models of bilingual lexical organization

The bilingual lexical organization is a difficult question in the field of psycholinguistics. From the past few decades researchers are trying to find the representation of mental lexicon in bilingual's brain. There are few models proposed to support or reject the hypothesis. All models distinguish two levels of representation-one lexical with two language specific stores and one conceptual, comprising a single store. According to Kroll and De Groot (1997) word representation in bilingual literature is decomposed into form and meaning, the former represented at the lexical level and latter at the conceptual level. Various models have been proposed on the basis of connections within and between lexical and conceptual level of representation.

Hierarchical models

(a) Word association model (Potter, VonEckhart & Feldman, 1984): In the Word Association Model, lexical representations from L1are directly linked to the conceptual system whereas, the words of L2 are connected only to L1 and have no direct connections to the conceptual system. That is if bilingual needs to access the meaning of L2 word then first there would be an activation of corresponding L1 word. Only then, he or she can access the meaning of the word.

(b) Concept mediation model (Potter et al.,1984)

It suggests that representations of the two languages are not directly connected. Instead the two language representations operate as separate systems that each directly connect to a modal conceptual system.

(c) Revised Hierarchical model (Kroll & Stewart, 1994)

This assumes that words in a bilingual's languages have separate word form representations but shared conceptual representations. Two routes lead from an L2 word form to its conceptual representation-the word association route, where concepts are accessed through the corresponding L1 word form, and the concept mediation route, with direct access from L2 to concepts.

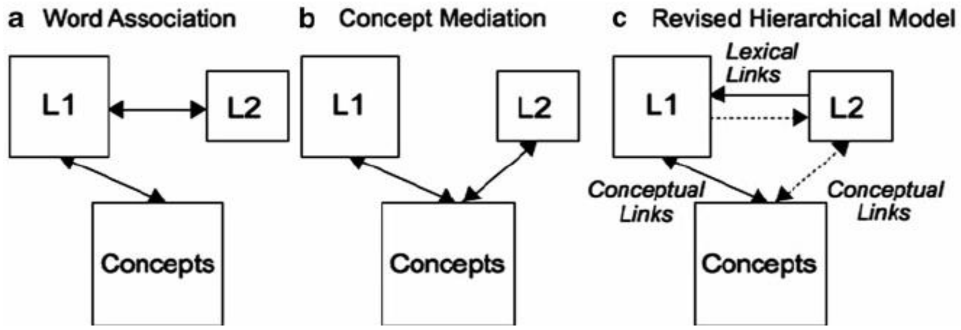

Figure 2.1. Hierarchical models (Source: Menenti & Indefrey, 2006)

When Potter et al. (1984) tested these models on bilinguals they found that L1-L2 (forward) translation was faster than L2 picture naming since picture naming requires the retrieval of L1, L2 and the concepts whereas forward translation requires only L1 and L2 lexical retrieval. Later, Kroll and Stewart (1994) stated that the time taken during the translation from L2 to L1 is faster than L1 to L2 i.e. there is an asymmetry in the lexical and conceptual connections between L1 and L2. They posited that this asymmetry is because the concept mediation takes place only in L1-L2 translation. This view of Kroll and Stewart is known as the revised hierarchical model (RHM). Thus, RHM stands by two aspects: first, there are both lexical and concept mediated links between L1 and L2. The lexical link is stronger in L2-L1 and conceptual link is stronger in L1-L2 direction. Second, the connections between the lexical and conceptual links are dependent on the language proficiency. According to this model, both lexical and conceptual links are active in the bilingual memory, but the strength of the links differs as a function of fluency in L2 and relative dominance of L1 over L2. The conceptual asymmetry results from the evidence that L1 words are more likely to engage semantic processing than their L2 translation equivalents, given the assumption that the activated concepts are shared by both L1 and L2. After L2 proficiency is achieved, the lexical link from L2 to L1 remains but the conceptual links between L2 lexical items and the concepts are established. As L2 proficiency increases, direct access to concepts from L2 will be gradually established and backward translation should not differ from forward translation because of L2 conceptual mediation.

Connectionist models

The set of models called the connectionist models also attempt to explain the bilingual memory as explained here. BIA (Bilingual Interactive Activation) and BIA +BIA (Djkstra and Van Heuven,1998) is an extension of Interactive Activation model (McClelland and Rumelhart,1981).The basic assumption of this model is integrated lexicon and it is successful in extending effects observed in single language to bilinguals. According to the BIA model, when a string of letters is presented, the visual input will have an impact on particular features at each letter position. This activation of these related features will subsequently stimulate the processing of the letters that contain these features and at the same time inhibit the processing of the letters for which the features are not activated; the stimulated letters further excite words in both languages which contain the activated letter while all other words are inhibited. At the word level words are inhibited depending on the features irrespective of the language to which they belong to. Word nodes activated in one language send activation on to the corresponding language node; also, activated language nodes send inhibitory feedback to all word nodes in the same and the other languages. Thus, the main function of these language nodes is to compile activation from words in the language they represent and inhibit the active words of the other language. The activation of the language nodes reflects the amount of activity in each lexicon in bilinguals provided the features of the words in both the languages in the visual mode matched (Walter, Van Heuven, Dijkstra &, 1998).Target word recognition in one language is influenced by the neighborhood density and frequency of such orthographically similar words in the other language (Andrews, 1989, 1992; Carreiras, Perea & Grainger, 1997).

BIA was further extended as BIA + (Dijkstra & Van Heuven,2002) which speaks of two processes within the lexico-semantic system in bilinguals: An automatic or bottom- up process which is essentially driven by stimulus input and involves modification of the level of activation and an intentional or top-down process that alters the response to the signals coming from the bilingual lexico-semantic system, but does not modify activation levels within the system. But, 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 again questions this approach. Even though researchers have agreed upon the presence of a separate semantic or conceptual level in bilingual memory structure, there is no emphasis on such concept in BIA.

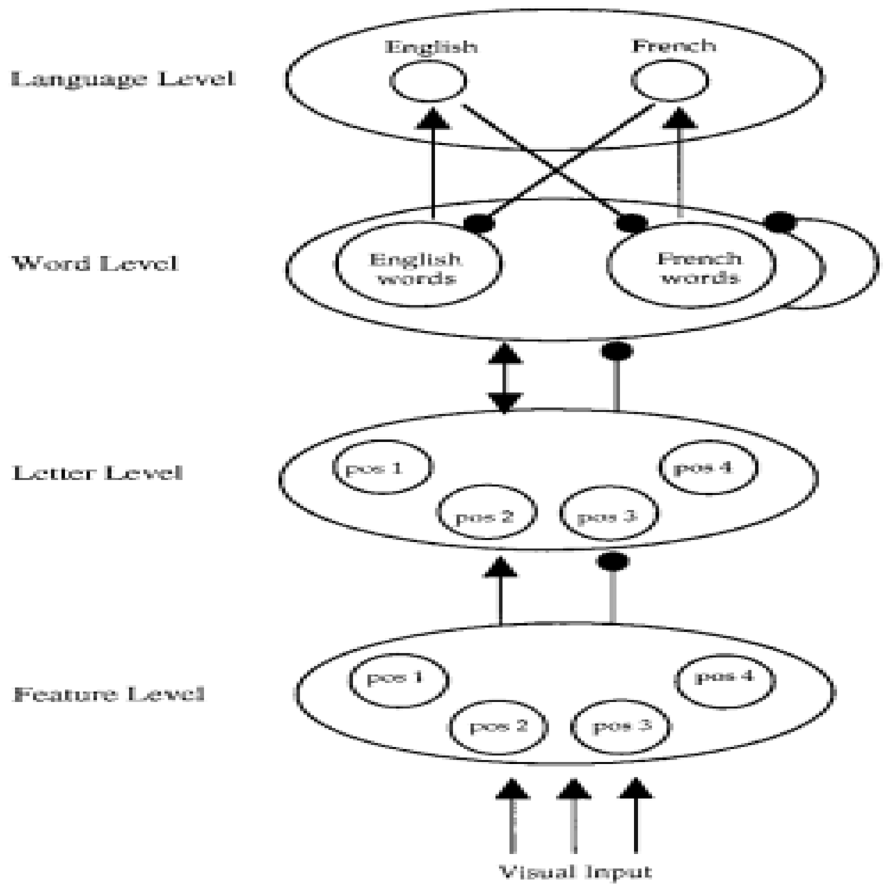

*Figure 2.2.*Bilingual Interactive Model (BIA)(Source: Dijkstra & Van Heuven, 1998).

2.2.2 Representation of translation equivalents in bilingual lexicon

The representation of translation equivalents in bilingual lexicon can have two assumptions. It assumes that the translation equivalents of both the languages can either be directly connected through connections between the forms of two languages (word association hypothesis), or indirectly connected via a shared semantic representation between the two languages (concept mediation hypothesis). This shared semantic representation further could either be localist (a single node corresponding to the shared concept) or distributed across a set of semantic features or meaning units (DeGroot, 1992), or both. In addition to these, a hierarchical model of bilingual processing has been put forth (Kroll & Sholl, 1992; Kroll & Stewart, 1994), where the level of L2 proficiency determines the degree to which bilinguals rely upon form to form connections or word association as opposed to concept mediation. Frenck-Mestre and Prince (1997) in contrast have demonstrated that L2 processing was independent of L1 translation links in less proficient speakers and also highlights concept mediation. Translational equivalent primes result in faster reaction times relative to unrelated primes (Keatley et al., 1994; Gollan et al., 1997; Jiang, 1999; Jiang & Forster, 2001; Basnight-Brown & Altarriba, 2007; Duyck & Warlop, 2009; Dunabeitia & Perera, 2010; Schoonbaert, 2011). Many translational priming studies suggest that translation equivalents have a shared representation (Keatly et al. 1994; Dunabeitia et al. 2010; Schaeffer, Paterson, & McGowan, 2014) and activation of shared representations facilitates automated processing (Schaeffer & Carl, 2013).

One of the models which explain the translational priming mechanism is the Sense model. The Sense model assumes that most words have different meanings according to the context in which they are used and that the range of senses that a word has will differ across languages. Translation equivalents typically share the dominant sense, but may differ in the remaining senses. Thus, translational priming depends on the representation of L1 and L2 at semantic level due to difference in the senses activated for L1 and L2. Translation priming also depends on the ratio of senses which prime and those that do not prime the senses associated with the target. In order to facilitate priming, it is essential to activate an ample proportion of the target senses. Priming from L1 to L2 has a stronger effect because the L1 prime can activate greater proportion of the L2 target senses. On the other hand, priming from L2 to L1 is weaker because the L2 prime might activate only the dominant sense of the L1 target, thus reducing the ratio of primed to unprimed senses associated with the L1 target compared to that in the L1 to L2 direction. This asymmetrical activation affects the degree of priming depending on the type of task selected; specifically more in a lexical decision task. Since no category information is available in lexical decision task, filtering effect with respect to the category will not be present. Hence, there will be no increase in the ratio of primed to unprimed senses in the L2–L1 direction because of which, no priming is observed. Whereas in semantic categorization task, the category which has been provided is assumed to act as a kind of filter and restricts the activation to just the category-relevant features of the target. Therefore, it increases the ratio of primed to the unprimed senses even in case of L2–L1 priming. This explanation is referred to as the Category Restriction Hypothesis (Finkbeiner, Forster, Nakamura & Nicol, 2004). The sense model, in general, claims the idea of asymmetrical lexical and semantic representations between L1 and L2 in bilingual mental lexicon, which in turn causes the asymmetry in terms of translation during lexical decision.

Wang & Forster (2010) conducted a study to investigate whether the translation effect occurred only 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. However, the sense model claims translation symmetry in semantic categorization task with the assumption that the category serves as a filter to eliminate the representational asymmetry. Only Sense Model is able to provide an account for the priming asymmetry and its dependence on the task till date.

2.2.3 Translational processing in bilinguals during visual word recognition

The studies in this regard have aimed to identify the way in which the words of both the languages in bilingual are connected to each other and also to their semantic representations (Potter, So, Von Eckhardt, & Feldman, 1984).One of the most interesting findings reported was a consistent asymmetric pattern of priming effects in the translation pairs; semantic interference was observed only in L1-L2 direction and not vice versa (Kroll & Stewart, 1994). The forward translation (L1 to L2) was semantically mediated and backward translation (L2 to L1) took place without any semantic mediation. Schwanenfluegel and Rey (1986) studied the influence of cross language semantic and translation priming in lexical decision in early Spanish-English bilinguals (300ms SOA). Results revealed a robust priming effect in both L1-L2 and L2-L1 directions. Therefore, Tzelgov and Ezra, (1992) suggested that this asymmetry across individuals is not systematic and does not show a specific trend. Recent study conducted by Kroll, Van Hell, Tokowicz, & Green (2010) has suggested the existence of semantic mediation in backward translation and also found that backward translation task was easier than forward translation task. This result was interpreted as evidence showing asymmetry in the connections between translation equivalents; the existence of more efficient or stronger connections between L2 words and their L1 counterparts as compared to L1 words and their L2 translations.

Studies on language processing bilingual, experimental paradigms of semantic and translation priming are widely used to explore the structure of bilingual lexicon. Priming paradigms facilitate study of automatic processing that is crucial to an understanding of language processing in bilinguals. In Translation priming, prime word will be presented in one language (L1/L2), and the target word will be presented in the other language (L1/L2), which will be the translation of the prime word.In translational priming, presentation of a prime words will automatically causes lexical entry (Forster & Davis,1984) to be activated so that less target processing has to be done before a response is made [short SOAs (Stimulus Onset Asynchrony: The amount of time between the beginning of the prime and the beginning of the target)].

2.3 Methods to study visual word recognition

Visual word recognition is commonly studied through psycholinguistic experiments with reaction time measures. Reaction time in the context of visual word recognition refers to the time taken to recognize the word presented visually. The response of recognition is usually noted through a button press indication in psycholinguistic experiments. In addition to the speed of recognition, the accuracy in recognizing the word is also considered. The commonly used tasks in the literature are lexical decision, lexical judgment, and lexical naming.

2.3.1 Lexical decision, Lexical judgment and Lexical naming

In the lexical decision (LD) task, the participant makes a speeded manual decision to a letter string on the computer screen that whether it is a word or non-word. Lexical judgment (LJ) refers to an advanced decision as in judging whether the target word is translated word of the given word or not. In the naming task (NAM), the participant speaks aloud, as quickly as possible, a word that is printed on the screen. In both tasks, the measures of interest are the speed and accuracy of response. Because responses are speeded, the process of identifying a word is automatic, not labored, and is thought to be similar in important ways to the word identification process in natural reading. These tasks have been used to examine the characteristics that affect word identification, including word length, spelling regularity, neighborhood density, bigram frequency, word frequency, imageability, morphological transparency, orthographic depth and bilingualism (Frost & Katz, 1992). Also, LD and NAM have been employed frequently to assess models of printed word identification, lexical access, syntactic and semantic processing i.e., hypotheses and theories about the reading process (Feldman & Andjelkovic, 1992). For example, LD and NAM tasks have been the main techniques used to study the extent of the involvement of phonology in printed word identification i.e., the importance of decoding-like processing (Lukatela & Turvey, 2000; Rastle & Coltheart, 2006). Ziegler and Goswami (2006) reports that LD task promotes processing at larger orthographic grain-sizes than the grapheme, e.g., at a multi-letter scale while fMRI data suggest that the NAM task promotes the generation of phonology for word identification more than the LD task.

The lexical decision (LD) and naming (NAM) tasks serve as the major tools for investigating how factors like morphology, semantic information, lexical neighbourhood and others affect word identification. Studies which have incorporated both the tasks are limited and hence little research into relation of performance of both tasks with reading ability is done. Study done by Katz et al(2011) reported that lexical decision and naming are two important tasks for the study of individual differences in reading.

Forster and Chambers (1973) proposed that lexical decision and naming words access the same representations of words in the mental lexicon. It is shown that the correlation between stimuli over tasks is due to word length in letters rather than word frequency. Further experiments with orthographically illegal non-words and orthographically legal but pseudo word like non-words showed that lexical decisions need not be influenced by word length but are influenced by word frequency. This suggests that the letter length effect is due to a post access spelling check. Finally, blocked naming, of words only, produces results similar to lexical decision, without length effects but with frequency effects indicative of lexical access. These results suggest two separate and independent routes to word naming, both of which are mediated by lexical knowledge.

Reaction time for naming and lexical decision for samples of words, non-words, and unfamiliar words were compared in the study of Kenneth et al (1973). It was found that naming times for words were shorter than for non-words, and that naming times for high frequency words were shorter than for low frequency words, indicating that word naming occurred as a result of a lexical search procedure, rather than occurring prior to lexical search. The naming paradigm employed by Fiez et al (1999) involves the activation of phonological codes and the articulation of word and non-word stimuli. In the lexical decision task, however, these processes are not necessarily required. It was also found that there was a positive correlation between naming times and lexical decision times for words, but not for non-words. Reaction time and naming time depends on the frequency of words. Both reaction time and naming time is short for high frequency words and long for low frequency words.

Lexical judgment in the present study refers to the ability to judge whether the target word is the translated word to the given word. Lexical judgment is more of higher cognitive function than lexical decision task. In lexical decision, we just have to see whether the word is present in the mental lexicon or not. But in judgment task, we have to see the word and we have to relate it to semantic features. Majority of the studies used for word recognition have used lexical decision paradigms. Research on visual word recognition using lexical judgment paradigm are limited in the literature.

2.4 Visual Word recognition in Indian (Kannada-English) bilinguals

Kannada is one of the major Dravidian languages in Southern part of India. It is considered to be the state language of Karnataka state and is spoken by around 20 million people. The literacy tradition of Kannada dates back to 1,200 years. The language has influentially undergone many changes in its morphological and orthographical structure (Rajapurohit, 1982). The following features differentiate Kannada from English:

(a) Phonetic arrangement of the script

(b) Inherent /a/ in consonants

(c) Short and long vowels

(d) Existence of retroflex consonants

(e) Differentiation between /la/ and /ḷa/; /na/ and /ṇa/

Kannada script (like Korean) is a mixture of syllabic and alphabetic principles. It is taught syllabically whereas English orthography is morphophonological (sequence of phonemes and its constituent morphemes are decoded simultaneously). English language is being taught to speak, read and write at a younger age in India and henceforth everyone in India is at least bilingual. English Bilingualism has now become an integral part in the modern multilingual Indian linguistic context. Since Kannada is a semi-syllabic language, visual representation of orthographic features has a unique relation with word recognition due to factors such as automaticity and inflectional morphology (Purushothama, 1986; Bhat, 2012, 2013).

Kannada and English being non-cognate language pair have shown significant priming effects in Johnson & Premas' study in 2005. Priming effects were found to be larger in L1-L2 direction which may be due to the stronger conceptual connections from L1 to concept store (Revised Hierarchical Model). The difference in the scripts has reduced the orthographic competition resulting in priming effect thus supporting the shared representation view of bilingual lexicon. Johnson concluded that this orthographic distance between Kannada and English did not negatively influence the priming effect but showed a clear evidence of semantic mediation in bilinguals.

Visual word recognition in Kannada and English can be assumed to be variable because these being two different languages with respect to grammar and orthography. This variance can be attributed to several factors of the language structures. Sweety, Meera, Aishwarya and Jayashree (2009) have done a cross-language priming (translational and semantic) experiment on 18 healthy Malayalam-English bilingual adults for examining their lexical organization. They used a total of 126 word targets including translational equivalent word pairs, semantically related and semantically unrelated word pairs which were presented in both language directions. They did not find any difference with respect to the priming effects in either of the language directions, relatedness of the prime and target words and the two types of priming paradigm incorporated. But they have reported that the performance of bilinguals is better than monolinguals in terms of lexical decision which supports the assumption of revised hierarchical model (Kroll and Stewart, 1994). Prema, Abhishek, and Prarthana (2010) have reported that in Indian bilinguals, lexical priming is one of the convenient tools to examine the lexical representation. Research is being done in this regard using priming paradigm and these studies have reported on the lexical representation in Indian bilinguals (Deema, 2005; Pravesh, 2009; Sweety, 2009). The lexical representation in brain damaged bilingual individuals has also been studied (Rajani, 2005; Mandira, 2013).The lexical retrieval in Kannada-English bilinguals using masked priming tasks depends on the prime duration, orthographical structure and type of processing the orthography of Kannada and English languages (Niharika & Prema, 2015). The same was studied in older population using repetition priming paradigm (Shrilekha & Prema, 2015). However, these factors need to be explored in detail. In this regard, the present study aims at looking into visual word recognition using lexical decision and lexical judgment tasks in Kannada-English bilinguals using translation words.

CHAPTER 3

Method

The aim of the study was to examine the nature of visual word recognition in Kannada-English bilinguals through lexical decision and lexical judgment tasks of translated words.

The objectives of the study were

3) To compare the performance of bilinguals on visual word recognition between lexical decision and lexical judgment tasks.
4) To examine the reaction time and accuracy for visual word recognition in lexical decision and judgment in Kannada-English bilinguals.

3.1 Participants

30 bilingual adults (Kannada-English) in the age range of 18-25 years were selected for the study.

3.1.1 Participant selection criteria

- All the participants were native speakers of Kannada (L1), and have learnt English as their second language (L2).
- The participants were screened for visual acuity using Snellen chart (Snellen, 1862; British Standard Institution, 2003); neurological status on Mini Mental Status Examination (Folstein et al, 1975); childhood disability using WHO Ten Question Disability Screening Checklist (Singi, Kumar, Malhi & Kumar, 2007).

3.2 Procedure

3.2.1 Stimuli

Stimuli were used from online bilingual proficiency test (Prema, 2012), hosted in the website of All India Institute of Speech and Hearing.

3.2.1.1 Selection of stimuli for development of online bilingual proficiency test

Stimuli for the present study were selected from Prema (2012). Prema (2012) selected seven hundred words/three fifty each in Kannada and English that were subjected for familiarity rating on 3-point scale (2- very familiar,1-familiar,0-least familiar) by 3 experienced professionals. The words rated by the experts as 2 and 1 were selected for the final set of stimuli. The target stimuli selected are simple, concrete nouns. Stimuli are bi/tri syllabic words. A few complex abstract nouns were also included to increase the level of complexity in LDT.

The stimuli were programmed using DMDX software version 4.0. The target words, non-words and their prime words were programmed for presentation. There were 35 non-words and 65 words as target stimuli in the Kannada to English direction and 31 non words and 69 words were there in English to Kannada language direction. Each word was displayed in black color on white background. Priming stimulus was displayed in the center line of computer monitor whereas target stimulus appeared 5 centimetres above the centre line to ensure that the participants distinguish the prime and target. This was applied for the stimuli of lexical judgment task also. Each prime was displayed for 50 milliseconds in lexical decision task and first stimulus of lexical judgment was displayed for 2000 milliseconds. This was followed by an inter-stimulus duration of 250 milliseconds following which target stimulus was displayed for 2000 milliseconds for both the tasks. The maximum duration available for the participant to respond was 4000 milliseconds. The reaction time was measured as the time taken from the start of stimulus until the participant responds or until 4000 milliseconds, whichever occurs first. If the participant failed to respond to the target within 4000 milliseconds, the response was recorded as error, and inter-trial interval was initiated followed by a presentation of subsequent stimulus of the next pair of stimuli. The “1” key on key board is used to indicate “yes” response and “0” for “no” response.

3.2.2 Presentation of stimuli

Presentation of the stimulus was done via online mode. Participants were required to register in the web portal to carry out the test. Instructions were displayed on the screen. Each task took 15-20 minutes. Five trial items were presented for practice.

Task one: Lexical decision along with naming

Task two: Lexical judgment along with naming

Table 3.1

Stimuli duration and order of language directions

LDT		LJT	
Prime	Target	Prime	Target
English (50ms)	Kannada (2000ms)	English (2000ms)	Kannada (2000ms)
Kannada (50ms)	English (2000ms)	Kannada(2000ms)	English (2000ms)

3.2.2 Experimental tasks

3.2.2.1 Task one (lexical decision)

100 word pair stimuli from English and Kannada were presented in both language directions. Participant had to respond only for the second stimulus (target stimulus). Participant had to press “1” or “0” for word and non-word on the keyboard respectively.

Instructions

(1) Kannada-English condition

"You will see a Kannada word initially on the screen, then one English word will be displayed on the screen. You have to see whether the English stimulus is word or non-word and press "1" or "0" for word and non-word on the keyboard respectively and along with that read aloud the English Stimulus displayed."

(2) English-Kannada

"You will see an English word initially on the screen, then one Kannada stimulus will be displayed on the screen. You have to see whether the Kannada stimulus is word or non-word and press "1" or "0" for word and non-word on the keyboard respectively and along with that read aloud the Kannada stimulus displayed.

Table 3.2

Examples of stimuli LDT

Language direction	Words		Non-words	
	Prime	Target	Prime	Target
K-E	ಸೂಜಿ	needle	ಮನೆ	ESHO
E-K	water	ನೀರು	bone	ರುನೀ

Note: Refer ARF project 3.47 for entire stimuli set

3.2.2.2 Task two (Lexical judgment)

Participants were presented with stimulus on the screen; participant had to silently read the first stimulus. After 250 ms, target stimulus was presented. Participant had to press '0' or '1' by deciding whether the target stimulus was the translated word of the first stimulus presented. If it is translated word, then participant had to press ‘1’, if not, press ‘0’ on the keyboard. 100 stimuli each from Kannada and English were presented in both language directions for this task also.

Instructions

(1) Kannada- English

“You will see a Kannada word initially on the screen, You have to read the word aloud and then one English word will be displayed on the screen. You have to see whether the English stimulus is the translated word of the Kannada word given initially and press “1” or “0” for translated word and untranslated word on the keyboard respectively and along with that read aloud the English stimulus displayed.”

(2) English-Kannada

“You will see an English word initially on the screen and then one Kannada stimulus will be displayed on the screen. You have to see whether the Kannada stimulus is the translated word of the English word given initially and press “1” or “0” for translated word and untranslated word on the keyboard respectively and along with that read aloud the Kannada stimulus displayed.”

Table 3.3

Examples of stimuli in LJT

Language direction	Words		Non-words	
	Prime	Target	Prime	Target
K-E	ರಕ್ತ	blood	ಮೊಲ	Telb
E-K	jasmine	ತೆರಚಿ	sculpture	ರುಮ

Note: Refer ARF project 3.47 for entire stimuli set

The study was counter balanced as shown in the table 3.4

Table 3.4

Representation of counter balanced groups

	15	15
1	**LDT**	**LJT**
	English-Kannada	English-Kannada
	Kannada-English	Kannada-English
2	**LJT**	**LDT**
	English-Kannada	English-Kannada
	Kannada-English	Kannada-English

Stimuli were same for both the tasks. Participants were allowed to have a break between the two tasks. Break was given in the range of one day to two days. Naming response was recorded in the inbuilt microphone of the lap top which was used for the tasks. Accuracy (both verbal and key press) and reaction time of the responses were considered for the analysis.

3.3 Scoring

The responses for key press were generated by the software and consisted of reaction time and accuracy of responses. Positive value indicated the accurate response whereas negative value indicated inaccurate response. Accuracy for verbal naming was calculated subjectively by listening to all recorded samples.

3.4 Statistical analysis

Descriptive statistics was done to analyse the data obtained from bilingual participants on visual word recognition. The reaction time, key press and verbal accuracy scores for all tasks of all the participants were compared for both the tasks (decision and judgment), for two (Kannada and English) language directions and for words and non- words. With-in group comparison was done for independent variables age and language.

CHAPTER 4

Results and Discussion

The aim of the study was to examine the nature of visual word recognition in Kannada-English bilinguals through lexical decision and lexical judgment tasks of translated words.

The objectives of the study were

1) To compare the performance of bilinguals on visual word recognition between lexical decision and lexical judgment tasks.
2) To examine the reaction time and accuracy for visual word recognition in lexical decision and judgment in Kannada-English bilinguals.

The dependent variables considered in the study were reaction time and accuracy of key press and accuracy of naming. The independent variables were the two tasks (lexical decision and lexical judgment) and language directions (L1 to L2 and L2 to L1) used in the paradigms.

Results of the study are discussed in the following sections

(1) Reaction time and accuracy for words and non-words

(2) Reaction time and accuracy in both language directions

(3) Reaction time and accuracy between both the tasks

(4) Comparison between verbal accuracy and accuracy for keypress

(5) Comparison between counter balanced group

For statistical analysis, SPSS (Statistical Package for the Social Sciences) – Version 20.0 software was used. Descriptive statistics and non-parametric tests were used to derive statistical values. Descriptive statistics was employed to calculate the mean and standard deviations of the reaction time. Shapiro-Wilks test for normality was carried out to check the normality. Since the data did not satisfy the normality condition, non-parametric tests were selected for further statistical analyses.

4.1 Reaction time and accuracy of words and non-words

4.1.1 Reaction time

To compare the reaction time between words and non-words, Wilcoxon Signed rank test was performed. Table 4.1 shows the mean and standard deviation scores of reaction time in all the tasks for words and non words.

Table 4.1

Mean, minimum, maximum and SD for reaction time

Tasks	**Mean (in ms)**	**Minimum (in ms)**	**Maximum (in ms)**	**SD**
LDTEKW	1114.74	599.85	2046.94	403.11
LDTKEW	1054.94	566.24	1944.22	407.83
LJTEKW	951.59	573.63	1516.79	284.44
LJTKEW	835.53	463.07	1573.22	292.54
LDTEKN	1582.44	807.57	2757.47	606.77
LDTKEN	1477.11	786.57	2721.20	544.41
LJTEKN	1300.28	669.09	2530.31	403.64
LJTKEN	1079.34	620.13	2243.85	368.84

Note: LDT-Lexical decision task, LJT-Lexical judgment task, EK-English to Kannada, KE-Kannada to English, W-Word, NW-Non word

Table4.1 indicates that mean reaction time for words was shorter than for non-words than words in both lexical judgement and lexical decision tasks. Mean Reaction time for LDTEKW was 1114.74 ms and LDTEKN was 1582.44ms.Mean reaction time for LDTKEW was 1954.93 ms and for LDTKEN was 1477.11ms.

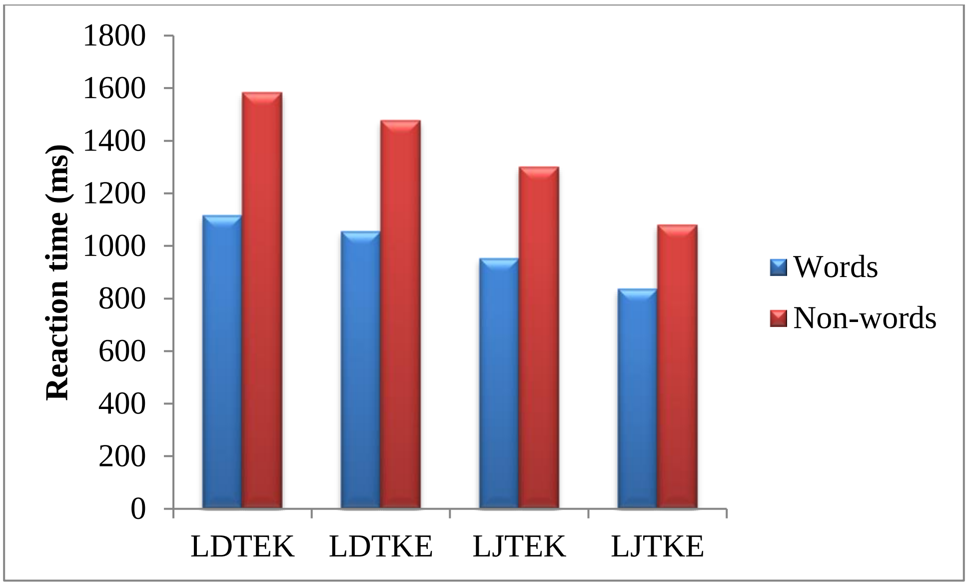

*Figure 4.1.*Mean reaction time for words and non-words across tasks and language directions.

As depicted in figure 4.1, reaction time for words was comparatively shorter than the reaction time for non-words in all the tasks. The reaction time was shorter in lexical judgment compared to lexical decision task. Reaction time was shorter for the language direction Kannada–English for both LDT and LJT and for both words and non-words.

Wilcoxon signed rank test was performed to test the level of significance between the reaction time of words and non-words across tasks and language directions. Significant difference was observed in the reaction time for words and non-words in both the tasks and in both language directions (LDTEK - $|Z| = 4.762$, $p<0.05$; LDTKE - $|Z| = 4.782$, $p<0.05$; LJTEK - $|Z| = 4.720$, $p<0.05$; LJTKE - $|Z| = 4.782$, $p<0.05$).

4.1.2 Accuracy for key press

The accuracy of the key press response for LDT and LJT were recorded for a total of 100 stimuli. The mean accuracy scores are tabulated in table 4.2.

Table 4.2

Mean, minimum, maximum and SD for accuracy of key press responses

Tasks	Mean	Minimum	Maximum	SD
LDTEKW	99.02	95.65	100.00	1.40
LDTKEW	98.20	93.80	100.00	1.72
LJTEKW	97.14	94.20	100.00	1.99
LJTKEW	97.33	95.38	100.00	1.81
LDTEKN	93.33	87.09	100.00	3.97
LDTKEN	93.04	82.85	100.00	4.73
LJTEKN	94.83	87.09	100.00	3.24
LJTKEN	96.66	85.71	100.00	4.12

Note: LDT-Lexical decision task, LJT-Lexical judgment task, EK-English to Kannada, KE-Kannada to English, W-Word, NW-Non word

The accuracy for LDT in English-Kannada for words is the highest among all the tasks (99.02) with the least being for LDT in Kannada-English for non words (93.04). However, the results reveal that the participants had more than 90% of accuracy in performing key press response during all the tasks. As depicted in figure 4.2, responses for words were more accurate than responses for non-words in all the tasks.

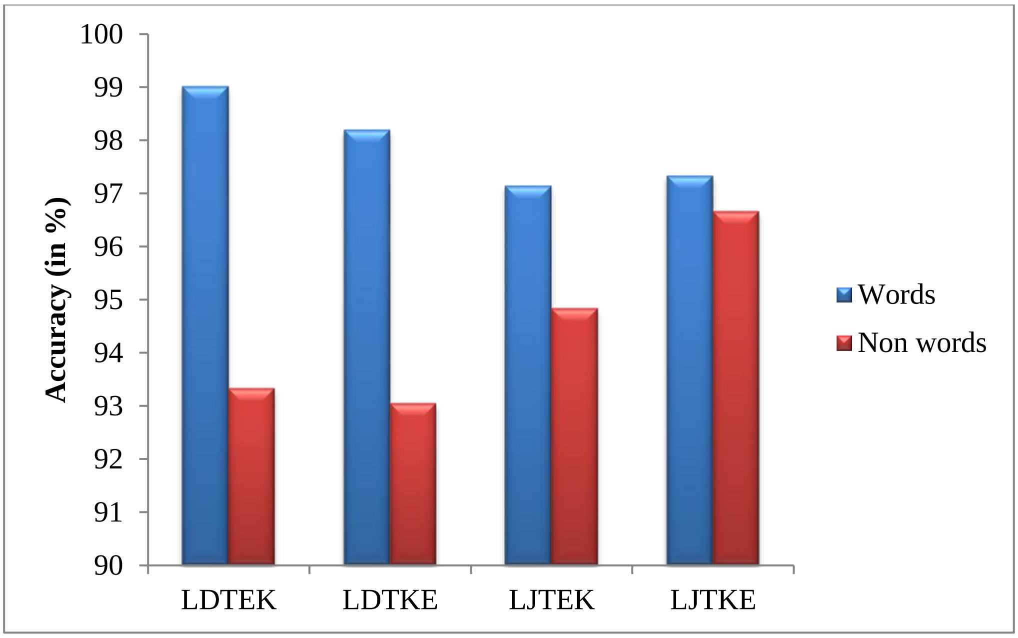

*Figure 4.2.*Mean key press accuracy for words and non-words across tasks and language directions.

Wilcoxon signed rank test was administered to find the significant difference between accuracy for words and non-words. Significant difference was found between accuracy for words and non-words except in the task LJTKE. (LDTEK - $|Z|4.507$, $p<0.05$; LDTKE - $|Z| = 4.361$, $p<0.05$; LJTEK - $|Z|= 3.214$, $p<0.05$; LJTKE - $|Z|= 0.409$, $p<0.05$) for the comparison between words and non-words.

4.1.3 Verbal Accuracy

Verbal accuracy was measured for lexical naming task. The verbal responses of the participants were recorded and coded for statistical analysis. The mean scores for verbal accuracy are tabulated in table 4.3

Table 4.3

Mean, minimum, maximum and SD for Verbal accuracy

Tasks	**Mean**	**Minimum**	**Maximum**	**SD**
LDTEKW	99.61	95.65	100.00	1.20
LDTKEW	99.56	95.65	100.00	1.15
LJTEKW	99.75	97.10	100.00	0.67
LJTKEW	99.79	98.46	100.00	0.53
LDTEKN	97.80	93.54	100.00	2.41
LDTKEN	97.41	91.42	100.00	2.64
LJTEKN	98.39	93.54	100.00	2.20
LJTKEN	98.86	94.28	100.00	2.07

Note: LDT-Lexical decision task, LJT-Lexical judgment task, EK-English to Kannada, KE-Kannada to English, W-Word, NW-Non word

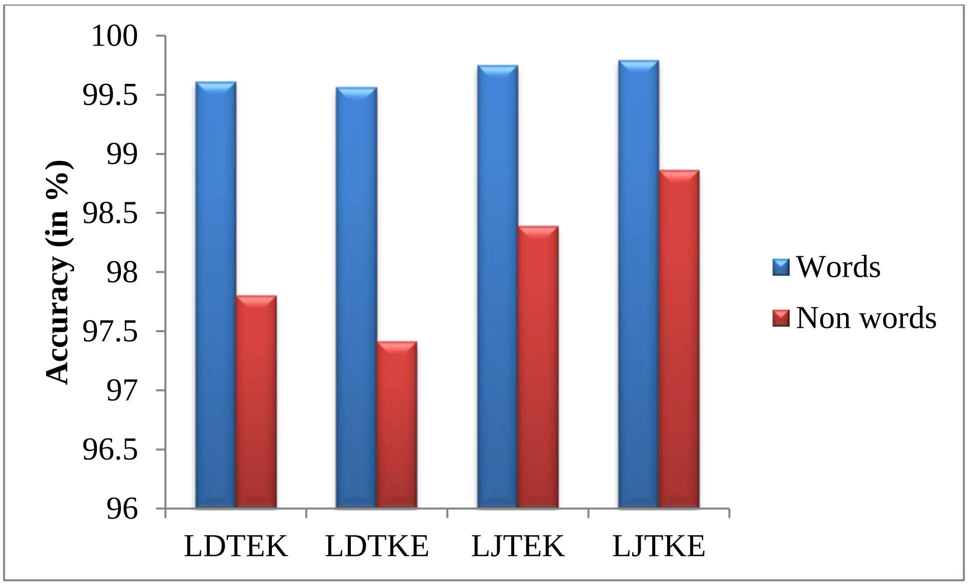

*Figure 4.3.*Mean verbal accuracy for words and non-words for words and non-words across tasks and language directions.

Figure 4.3 depicts verbal accuracy for naming task. It was found that words had relatively accurate recognition than non words. Further, Wilcoxon signed rank test was employed to find whether there is any significant difference between verbal accuracy of words and non-words (LDTEK - $|Z| = 3.062$, $p<0.05$; LDTKE - $|Z| = 3.739$, $p<0.05$; LJTEK - $|Z| = 3.024$, $p<0.05$; LJTKE - $|Z| = 2.307$, $p<0.05$).

4.2 Pair wise comparison between two language directions

Wilcoxon signed rank test was performed to compare the performance across tasks for both language directions (Kannada- English and English to Kannada).

Table 4.4

Pair wise comparisons for reaction time

Pairs	|Z| Value	P value
LDTKEW-LDTEKW	2.273	.023
LJTKEW-LJTEKW	3.507	.000
LDTKEN-LDTEKN	2.293	.022
LJTKEN-LJTEKN	3.630	.000

The tabulated values in table 4.4 indicate significant difference in reaction time in language direction in LJT and LDT for both words ($|Z|=2.273$ for LDT; $|Z|=3.507$ for LJT, $p<0.05$) and non-words ($|Z|=2.293$-LDT; $|Z|=3.630$-LJT, $p<0.05$).

Table 4.5

Pair wise comparison for accuracy of key press

Pairs	|Z| value	P value
LDTKEW-LDTEKW	2.808	.005*
LJTKEW-LJTEKW	.076	.940
LDTKEN-LDTEKN	.443	.658
LJTKEN-LJTEKN	2.852	.004*

*p<0.05

Table 4.5 indicates that there is a significant difference in accuracy for words in LDT and for non-words in LJT across language directions. In LDT Kannada-English had greater accuracy, but in LJT English-Kannada language direction scored more accuracy than Kannada- English.

Wilcoxon signed rank test was administered to compare the responses in verbal accuracy performance across language directions. Obtained "p" ($p>0.05$) value indicated that there is no significant difference for verbal accuracy in both language directions for all tasks.

4.3 Comparison Across tasks

4.3.1 Reaction time

Wilcoxon signed rank test was administered to compare the reaction time across tasks.

Table 4.6

Pair wise comparison for reaction time across tasks

Pairs	**|Z| value**	**P value**
LJTEKW-LDTEKW	2.725	.006
LJTKEW-LDTKEW	4.515	.000
LJTEKN-LDTEKN	2.849	.004
LJTKEN-LDTKEN	4.042	.000

Values from the above table indicate that there is significant difference in the reaction time for both words and non-words across the tasks.LJT (|Z| value for words in KE direction is 4.042 and EK direction is 2.849) took less reaction time than LDT (|Z| value for words in KE direction is 4.515 and EK direction is 2.725) as mentioned in the table 4.1.

4.3.2 Accuracy

Wilcoxon signed rank test was administered to compare the Accuracy across tasks.

Table 4.7

Pair wise comparison of accuracy across tasks

Pairs	|Z| value	P value
LJTEKW-LDTEKW	3.754	.000*
LJTKEW-LDTKEW	1.737	.082
LJTEKN-LDTEKN	1.626	.104
LJTKEN-LDTKEN	3.027	.002*

*p<0.05

Values from the above table indicate that there is a significant difference for the language direction English-Kannada for words and Kannada-English for non-words in LDT and LJT tasks respectively. Accuracy in LDT was better for words than LJT and accuracy in LJT was better for non-words as shown in the table 4.2

4.3.3 Verbal Accuracy

Wilcoxon Signed Rank test was used to see whether there is any significant difference in the measures of verbal accuracy across tasks. P value ($p>0.05$) showed no significant difference in verbal accuracy measures across tasks LDT and LJT for words and non-words.

4.4 Comparison of accuracy of key press and Verbal Naming

To compare between the results of nonverbal accuracy and verbal accuracy, Wilcoxon signed rank test was administered. P value indicated there is a significant difference for all the tasks.

Table 4.8

Pair wise Comparison of Verbal Accuracy and key press accuracy within the tasks

Pairs	|Z| value	P value
ACCLDTEKW-VERACCLDTEKW	2.309	.021
ACCLDEKEW-VERACCLADTKEW	3.725	.000
ACCLJTEKW-VERACCLJTEKW	4.270	.000
ACCLJTKEW-VERACCLJTKEW	4.255	.000
ACCLDTEKN-VERACCLDTEKN	4.405	.000
ACCLDTKEN-VERACCLDTKEN	4.255	.000
ACCLJTEKN-VERACCLJTTEKN	4.191	.000
ACCLJTKEN-VERACCLJTKEN	3.100	.000

Note: ACC-key press Accuracy; VERACC-Verbal Accuracy

Table 4.2 and 4.3 shows that accuracy for verbal naming was more accurate than the accuracy for key press for all the tasks.

4.5 Comparison between counter balanced groups

Since the present study was counter balanced for the tasks, Mann Whitney U test was carried out to see whether there is an effect of order of tasks in the study. However, no significant difference was seen in the comparison of counter balanced groups ($p < 0.05$).

To summarize, the statistical analyses revealed significant difference for the dependent variables considered such as reaction time, key press accuracy and verbal accuracy for word and non-words. Non-words showed longer reaction time and poor accuracy compared to words. On comparison of performance across language directions, tasks in Kannada-English language direction showed better reaction time compared to English-Kannada language direction. On comparing accuracy, naming accuracy was better than key press (motor) accuracy.

4.6 Comparison between words and non-words

The results for the dependent measures of the study such as reaction time and accuracy (key press and naming) were better for words than non-words. Results showed shorter reaction time and greater accuracy (key press and naming) for words across all the tasks. This better recognition of words over non-words is in consensus with the study done by Kenneth et al (1973) which showed that reaction time for naming words were shorter than non-words. The representation of true words in the mental lexicon makes it easy to search and select from the mental lexicon. This easy access makes the recognition faster for words compared to non-words. On the other hand, mental lexicon is assumed not to have any specified representation for non-words or pseudo words which may result in an exhaustive search of the lexicon before the decision is made (Forster & Bednall, 1976).Experimental tasks involving the rapid presentation of the letter strings of words and non-words have revealed the influence of letter position cues. The recognition of initial letter strings of words facilitates faster recognition of the entire word unlike non-word. These results in better performance for word recognition compared to non-word recognition. (Johnston & McClelland, 1973; Maris, 2002; Paap, Chun & Vonnahme, 1999).

4.7 Comparison between two Language directions

4.7.1 Reaction time

Reaction time for words and non-words was found to be better in K-E language direction for both LDT and LJT. In, K-E language direction the prime was presented in Kannada and target in English language. The presentation duration of prime varied in LDT and LJT with a relatively shorter prime duration in LDT (50ms) than LJT (2000ms). This finding can be explained based on the fact that more than 80% of the participants learnt Kannada as their first language. Thus Kannada being their mother tongue could have facilitated the access compared to the second language, English. The results also support the Revised Hierarchical Model. RHM posits that there is a link between the lexicon and concepts of L1 and L2 which is supported by the occurrence of translational priming effect. Further, RHM emphasizes the influence of first language proficiency in bilinguals which is also supported by the finding that priming effect has taken place only in L1 to L2 direction. And also automaticity and orthography in reading Kannada words has contributed to the faster reaction times for identification of targets in L2 (English) when the prime was presented in L1 (Kannada). Automaticity in word reading refers to the simultaneous or parallel word reading strategy based on the visual structure of the words. Highly skilled readers process the words automatically and are less affected by conceptual information. They can read words even if they are presented for a brief duration. Hence, the knowledge of the rules of orthography is an important factor in word recognition (Purushothama, 1986). Unlike English, factors such as word frequency, class, imageability and/or concreteness do not influence the speed of reading words in Kannada by skilled Kannada readers (Karanth, Mathew and Kurien, 2004).

4.7.2 Accuracy for key press

The mean accuracy scores for key press response were greater than 90% for all the tasks across both the language directions (E to K and K to E). Significant difference was seen for the language directions in LDT of words and LJT of non-words. Facilitation of visual word recognition in E to K direction for words demonstrates backward translation priming effect. An evidence for backward translation priming effect in lexical decision is supported by the study done by Tzelgov & Ezra (1992) where they suggested that this asymmetry across individuals is not systematic and does not show a specific trend. When late bilinguals' L2 knowledge and proficiency gradually increase, their mental representations of L2 will become less dense and more organized. In other words, less confusion and better organization of semantic associations for L2 will occur. Such changes may cause the priming effects from L2 to L1 stronger and the "priming asymmetry" less salient as found in our experiment (Zhao, Li &Liu, 2011).).

A significant difference was evidenced in the recognition of non-words in K to E language direction in LJT. The presentation of prime in Kannada facilitated the identification of target in English on judgment task. The language proficiency and usage of the participants recruited for the study is higher in Kannada language than English language. The higher proficiency in Kannada language was assured for the domains of speaking and reading. Recruited participants being skilled readers in Kannada language could access and recognize the non-words accurately even in the task which demanded advanced decision (judgment).

4.8. Pair wise comparison across tasks

4.8.1 Reaction time

Results showed shorter mean reaction time for LJT task compared to LDT task. One of the components that varied between LDT and LJT was the prime duration. The prime was presented for a brief duration of 50ms in LDT whereas prime was presented for 2000ms in LJT. Skilled readers in Kannada could sense the prime even at 50ms of presentation which indicates the robust effect of orthographic structure on visual word recognition in Kannada-English bilinguals (Niharika & Prema, 2015). Longer prime duration (judgment) in translational priming conditions would have led the participants to use their strategic processing for categorizing the lexicon thus leading to shorter reaction time. The prime duration preceding the target word was very short, that is 50ms. Failure to recognize the prime in LDT would have led to longer reaction time.

4.8.2 Accuracy for key press

Results revealed that accuracy for key press was higher for LDT than LJT for words. LDT requires the participant to decide whether the target stimulus is a word or non-word. This task places relatively lesser demand because the participants have to do a lexical search within the mental lexicon with existing lexemes. But in the case of LJT, the participants are required to access the semantic feature of the presented stimuli and they need to match the semantic features to the target word. This complexity of the LJT may delay the participant in performing a subsequent motor response (key press) following visual word recognition. This delay in response leads to the activation of strategic processing might interfere in the process of judgment. This interference diverts the participants from giving an accurate response. These results can be explained based on Forster's bin model according to which word recognition takes place through a sequential orthographic, phonological and semantic search. The task demands of LJT require the search through all the three representations to judge the translational equivalents. However the task demands of LDT are relatively simpler which may have led to an effortless search compared to LJT (Forster 1989; Forster, Mohan, & Hector, 2003).

4.9 Comparison between key press accuracy and verbal accuracy

The results revealed that the verbal accuracy was greater than the key press accuracy across all the tasks. It can be attributed to the ratio of word to non-word stimuli in the tasks. The stimulus set contained more number of words than non-words. When non-word ratio is below 0.50 (i.e., the experimental stimuli consists of more word pairs), than non-word pairs individuals may be biased to give a response when non-word is presented, because the number of words exceeded non-words in the present experimental list. However, when the non-word ratio is above .50 participants may choose non-word; because non-words are presented more frequently than words (McNamara & Holbrook, 2003). Key press is more an automatic process, but verbal naming needs consciousness and cannot be automatically controlled. This can be accounted for the relative incorrectness in key press compared to verbal responses.

The findings of the study provided a new insight towards visual word recognition in Kannada-English bilinguals using an online proficiency test. The experiment comprised of the tasks (lexical decision and judgment) to recognize the set of translational equivalents in two different language directions. The present study incorporated an additional task of naming the target word which stood unique amongst usual key press reaction time tasks. The study evidenced better recognition for words which possess a representation in the mental lexicon. The recognition of translational equivalents across language directions was variable with respect to reaction time and accuracy scores. Lexical judgment was found to be faster than decision which is discussed in the line of prime duration. Participants had greater accuracy in performing lexical decision than judgment which is explained with respect to the strategic processing mechanism. The novel task of naming had greater accuracy than key press, although done simultaneously which is accounted for the word and non-word ratio in the stimulus set considered for the study. Also, the automaticity in performing a motor response may influence the participants in performing the task accurately.

CHAPTER 5

Summary and conclusion

Visual word recognition plays a major role in understanding the representation of mental lexicon. Representation of mental lexicon in bilinguals is a topic of research since so many years between psycholinguistics. Word recognition is influenced by the nature of language structure as well as the number of languages used by a person. Other factors influencing word recognition are frequency effect, proficiency in the language etc. Since India is a land of so many languages and nowadays every one learns English as their second language, it is important to know the representation of orthographically different languages in the mental lexicon. Cross language studies have been done by using lexical decision, lexical priming, lexical judgment task etc. The present study addressed the issue of visual word recognition in Kannada-English bilinguals through lexical decision and judgment tasks by employing a translation priming paradigm.

The objectives of the study were

5) To compare the performance of bilinguals on visual word recognition between lexical decision and lexical judgment tasks.
6) To examine the reaction time and accuracy for visual word recognition in lexical decision and judgment in Kannada-English bilinguals.

30 bilingual adults (Kannada-English) in the age range of 18-25 years were selected for the study.All the participants were native speakers of Kannada (L1), and have learnt English as their second language (L2).

There were two experimental paradigms used. Lexical Decision Task (LDT) and Lexical Judgment Task (LJT).They were done in four conditions.

- Lexical Decision in English- Kannada direction
- Lexical Decision in Kannada-English direction
- Lexical Judgment in English- Kannada Direction
- Lexical Judgment in Kannada-English Direction

Stimuli were used from online bilingual proficiency test (Prema, 2012), hosted in the website of All India Institute of Speech and Hearing. Presentation of the stimulus was done via online mode. Participants were required to register in the web portal to carry out the test. Instructions were displayed on the screen. Each task took 15-20 minutes. Five trial items were presented for practice. Participants were asked to press 1 for word and 0 for non-word in LDT and 1 for translated word and 0 for untranslated word in LJT. The participants were asked to read aloud the target stimulus for LDT and Both first and target stimulus for LJT. Naming responses were recorded. Reaction time and accuracy measures of key press responses were calculated objectively and Verbal naming accuracy was calculated subjectively by listening to all responses.

Descriptive statistics was done to analyse the data obtained from bilingual participants on visual word recognition. The reaction time, key press and verbal accuracy scores for all tasks of all the participants were compared for both the tasks (decision and judgment), for two (Kannada and English) language directions and for words and non- words. With-in group comparison was done for independent variables age and language.

The results revealed

- Reaction time, key press accuracy and verbal naming accuracy were better for words than non-words in all tasks.

- Reaction time was lesser for Kannada-English language direction in all tasks
- Accuracy for key press was better for words in Kannada-English direction in LDT and was better for non-words in English- Kannada in LJT.
- Accuracy for key press was better in LDT than LJT.

The findings of the study provided a new insight towards visual word recognition in Kannada-English bilinguals using an online proficiency test. The experiment comprised of the tasks (lexical decision and judgment) to recognize the set of translational equivalents in two different language directions. The present study incorporated an additional task of naming the target word which stood unique amongst usual key press reaction time tasks. The study evidenced better recognition for words which possess a representation in the mental lexicon. The recognition of translational equivalents across language directions was variable with respect to reaction time and accuracy scores. Lexical judgment was found to be faster than decision which is discussed in the line of prime duration. Participants had greater accuracy in performing lexical decision than judgment which is explained with respect to the strategic processing mechanism. The novel task of naming had greater accuracy than key press, although done simultaneously which is accounted for the word and non-word ratio in the stimulus set considered for the study. Also, the automaticity in performing a motor response may influence the participants in performing the task accurately. Future studies may incorporate naming the target stimulus along with key press in order to improve the accuracy.

5.1 Implications of the study

This study gives an insight to

- Visual word recognition in Kannada-English bilinguals
- The feasibility of using lexical priming and lexical judgment task for visual word recognition; translational priming as a method of study in visual word recognition in bilinguals.

5.2 Limitations of the study

- All the bilingual participants selected were not balanced or equally proficient in both the languages. They differed in terms of the usage of the languages (greater usage of Kannada language).
- Verbal naming along with key press was tedious for the participants
- Non words were not balanced in language directions
- The rationale for deciding the word to non word ratio is not explained

5.3 Future directions

- Word recognition in balanced bilinguals can be investigated
- Word recognition can be done across different age groups and genders
- Automatic recording of verbal naming responses can be done though the software

REFERENCES

Abhishek, B. P., & Prema, K. S. (2012). Automatic Versus Volitional Mechanisms of Lexical Retrieval in Persons with Aphasia. *Journal of Indian Speech Language and Hearing Association,* Volume 26 (2), 82-92.

Altarriba, J. (1992). The representation of translation equivalents in bilingual memory. *Advances in psychology, 83,* 157-174.

Andrews, S. (1992). Frequency and neighborhood effects on lexical access: Lexical similarity or orthographic redundancy?. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*(2), 234.

Basnight-Brown, D. M., & Altarriba, J. (2007). Differences in semantic and translation priming across languages: The role of language direction and language dominance. *Memory & cognition*, *35*(5), 953-965.

Becker, C. A. (1980). Semantic context effects in visual word recognition: An analysis of semantic strategies. *Memory & cognition*, *8*(6), 493-512.

Bhat, S. (2012). Morpheme segmentation for Kannada standing on the shoulder of giants. *In the proceedings of the WSANLP, 411-415.*

Bhat, S. (2013).Statistical Stemming for Kannada. *In the proceedings of WSANLP*, 25-33.

Bhattacharjee, M. (2013).*Cross Linguistic Priming in Kannada-English Bilingual non-fluent Aphasia.* An Unpublished Dissertation submitted to the University of Mysore.

Bowers, J. S. (2000). In defense of abstractionist theories of repetition priming and word identification. *Psychonomic Bulletin & Review*, *7*(1), 83-99.

Carreiras, M., Perea, M., & Grainger, J. (1997). Effects of orthographic neighborhood in visual word recognition: Cross-task comparisons. *Journal of Experimental Psychology-Learning Memory and Cognition*, *23*(4), 857-871.

Cattell, J. M. (1886). The time it takes to see and name objects. *Mind*, *11*(41), 63-65.

Cattell, J. M. (1886). The time taken up by cerebral operations. *Mind*, *42*, 220-242.

Chen, H. C., & Ng, M. L. (1989). Semantic facilitation and translation priming effects in Chinese-English bilinguals. *Memory & cognition*, *17*(4), 454-462.

Coltheart, M., Davelaar, E., Jonasson, T., & Besner, D. (1977). Access to the internal lexicon.

Coltheart, M. (1981). Disorders of reading and their implications for models of normal reading. *Visible language*, *15*(3), 245.

Coltheart, M. (1981).The MRC psycholinguistic database. *The Quarterly Journal of Experimental Psychology*, *33*(4), 497-505.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: a dual route cascaded model of visual word recognition and reading aloud. *Psychological review*, *108*(1), 204.

Deema, J. J. (2005). *Cross language priming in Normal Bilingual Adults.* An Unpublished Dissertation submitted to the University of Mysore.

De Groot, A. M., &Nas, G. L. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of memory and language*, *30*(1), 90-123.

de Groot, A. M. (1992). Determinants of word translation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*(5), 1001.

denHeyer, K., Briand, K., & Dannenbring, G. L. (1983). Strategic factors in a lexical-decision task: Evidence for automatic and attention-driven processes. *Memory & Cognition*, *11*(4), 374-381.

Dennis, I., Besner, D., &Davelaar, E. (1985). Phonology in visual word recognition: Their is more two this than meats the I. *Reading research: Advances in theory and practice*, *5*, 167-197.

Dijkstra, T., & Van Heuven, W. J. (1998). The BIA model and bilingual word recognition. *Localist connectionist approaches to human cognition*, 189-225.

Dijkstra, T., & Van Heuven, W. J. (2002). Modeling bilingual word recognition: Past, present and future. *Bilingualism: Language and Cognition*, *5*(03), 219-224.

Dijkstra, T., & Van Heuven, W. J. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and cognition*, *5*(03), 175-197.

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011).Masked translation priming effects with low proficient bilinguals. *Memory & Cognition*, *39*(2), 260-275.

Duñabeitia, J. A., Dimitropoulou, M., Uribe-Etxebarria, O., Laka, I., & Carreiras, M. (2010). Electrophysiological correlates of the masked translation priming effect with highly proficient simultaneous bilinguals. *Brain research*, *1359*, 142-154.

Durgunoğlu, A. Y., & Roediger, H. L. (1987). Test differences in accessing bilingual memory. *Journal of Memory and Language*, *26*(4), 377-391.

Duyck, W., & Warlop, N. (2009). Translation priming between the native language and a second language: New evidence from Dutch-French bilinguals. *Experimental Psychology*, *56*(3), 173-179.

Feldman, L. B., & Andjelković, D. (1992). Morphological analysis in word recognition. *Advances in psychology*, *94*, 343-360.

Fiez, J. A., Balota, D. A., Raichle, M. E., & Petersen, S. E. (1999). Effects of lexicality, frequency, and spelling-to-sound consistency on the functional anatomy of reading. *Neuron*, *24*(1), 205-218.

Finkbeiner, M., Forster, K., Nicol, J., & Nakamura, K. (2004).The role of polysemy in masked semantic and translation priming. *Journal of Memory and Language*, *51*(1), 1-22.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”: a practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric research*, *12*(3), 189-198.

Forster, K. I., & Bednall, E. S. (1976).Terminating and exhaustive search in lexical access. *Memory & Cognition*, *4*(1), 53-61.

Forster, K. I., & Chambers, S. M. (1973).Lexical access and naming time. *Journal of verbal learning and verbal behavior*, *12*(6), 627-635.

Forster, K. I. (1981). Priming and the effects of sentence and lexical contexts on naming time: Evidence for autonomous lexical processing. *The Quarterly Journal of Experimental Psychology*, *33*(4), 465-495.

Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *Journal of experimental psychology: Learning, Memory, and Cognition*, *10*(4), 680.

Forster, K. I., Mohan, K., Hector, J., Kinoshita, S., & Lupker, S. J. (2003).The mechanics of masked priming. *Masked priming: The state of the art*, 3-37.

Frenck-Mestre, C., & Prince, P. (1997). Second language autonomy. *Journal of memory and language*, *37*(4), 481-501.

Frost, R. (1998). Toward a strong phonological theory of visual word recognition: true issues and false trails. *Psychological bulletin*, *123*(1), 71.

Frost, R., & Katz, M. (Eds.).(1992). *Orthography, phonology, morphology and meaning* (Vol. 94).Elsevier.

Gerard, L. D., & Scarborough, D. L. (1989).Language-specific lexical access of homographs by bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*(2), 305.

Glushko, R. J. (1979). The organization and activation of orthographic knowledge in reading aloud. *Journal of experimental psychology: Human perception and performance*, *5*(4), 674.

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew-English bilinguals. *Journal of Experimental Psychology-Learning Memory and Cognition*, *23*(5), 1122-1139.

Gough, P. B. (1972). One second of reading. *Visible Language*, *6*(4), 291-320.

Grainger, J., O'regan, J. K., Jacobs, A. M., & Segui, J. (1989). On the role of competing word units in visual word recognition: The neighborhood frequency effect. *Attention, Perception, & Psychophysics*, *45*(3), 189-195.

Grainger, J. (1992). Orthographic neighbourhoods and visual word recognition. *Advances in psychology*, *94*, 131-146.

Grainger, J., & Jacobs, A. M. (1996). Orthographic processing in visual word recognition: a multiple read-out model. *Psychological review*, *103*(3), 518.

Grosjean, F. (1994). Individual bilingualism. *The Encyclopedia of language and linguistics, 3*, 1656-1660.

Jiang, N. (1999). Testing processing explanations for the asymmetry in masked cross-language priming. *Bilingualism: Language and Cognition, 2*(01), 59-75.

Jiang, N., & Forster, K. I. (2001).Cross-language priming asymmetries in lexical decision and episodic recognition. *Journal of Memory and Language*, *44*(1), 32-51.

Jin, Y. S. (1990). Effects of concreteness on cross-language priming in lexical decisions. *Perceptual and Motor Skills*, *70*(3_suppl), 1139-1154.

Keatley, C. W., Spinks, J. A., & De Gelder, B. (1994).Asymmetrical cross-language priming effects. *Memory & cognition*, *22*(1), 70-84.

Keatley, C., &Gelder, B. D. (1992). The bilingual primed lexical decision task: Cross-language priming disappears with speeded responses. *European Journal of Cognitive Psychology*, *4*(4), 273-292.

Kolers, P. A. (1963). Interlingual word associations. *Journal of verbal learning and verbal behavior*, *2*(4), 291-300.

Kroll, J. F., & De Groot, A. (1997). Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages.

Kroll, J. F., &Sholl, A. (1992).Lexical and conceptual memory in fluent and nonfluent bilinguals.Advances in psychology, 83, 191-204.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of memory and language*, *33*(2), 149.

Kroll, J. F., Van Hell, J. G., Tokowicz, N., & Green, D. W. (2010). The Revised Hierarchical Model: A critical review and assessment. *Bilingualism (Cambridge, England)*, *13*(3), 373.

Lukatela, G., & Turvey, M. T. (1994). Visual lexical access is initially phonological: 2. Evidence from phonological priming by homophones and pseudohomophones. *Journal of Experimental Psychology: General*, *123*(4), 331.

Lukatela, G., &Turvey, M. T. (2000). Do spelling variations affect associative and phonological priming by pseudohomophones?. *Attention, Perception, & Psychophysics*, *62*(1), 196-217.

Lupker, S. J. (1984). Semantic priming without association: A second look. *Journal of Verbal Learning and Verbal Behavior*, *23*(6), 709-733.

Massaro, D. W. (1975). Primary and secondary recognition in reading. *Understanding language: An information processing analysis of speech perception, reading, and psycholinguistics*, 241-289.

Morton, J. (1969). Interaction of information in word recognition. *Psychological review*, *76*(2), 165.

McClelland, J. L. (1979). On the time relations of mental processes: An examination of systems of processes in cascade. *Psychological review*, *86*(4), 287.

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: I. An account of basic findings. *Psychological review*, *88*(5), 375.

McCormack, P. D. (1977). Bilingual linguistic memory: The independence-interdependence issue revisited. *Bilingualism: Psychological, social, and educational implications*, 57-66.

McNamara, T. P., & Holbrook, J. B. (2003).Semantic memory and priming. *Handbook of psychology*.

Monsell, S., Doyle, M. C., & Haggard, P. N. (1989). Effects of frequency on visual word recognition tasks: Where are they?. *Journal of Experimental Psychology: General*, *118*(1), 43.

Monsell, S. (1991).The nature and locus of word frequency effects in reading. *Basic processes in reading: Visual word recognition*, 148-197.

Niharika, M. K., & Prema, K. S. (2015). *Prime type and Lexical Retrieval in Kannada-English bilinguals*. Master's dissertation submitted to University of Mysore, Mysuru.

Paap, K. R., Newsome, S. L., McDonald, J. E., & Schvaneveldt, R. W. (1982). An activation–verification model for letter and word recognition: The word-superiority effect. *Psychological review*, *89*(5), 573.

Paap, K. R., Johansen, L. S., Chun, E., &Vonnahme, P. journal ofExperimental Psychology: Human Perception and Performance. *Neighborhood frequency does affect performance in the Reicher task: Encoding or decision*.

Plaut, D. C., McClelland, J. L., Seidenberg, M. S., & Patterson, K. (1996). Understanding normal and impaired word reading: computational principles in quasi-regular domains. *Psychological review, 103*(1), 56.

Posner, M. I., & Snyder, C. R. R. (1975).Facilitation and inhibition in the processing of signals. *Attention and performance V*, 669-682.

Potter, M. C., So, K. F., Von Eckardt, B., & Feldman, L. B. (1984).Lexical and conceptual representation in beginning and proficient bilinguals. *Journal of verbal learning and verbal behavior*, *23*(1), 23-38.

Prema, K.S., (2010). *Development of test for Assessment of bilingual proficiency through lexical priming.* An ARF Project.3.47, AIISH, Mysore.

Purushothama, G. (1986). *Frame work for testing Kannada reading on the basis of automaticity, rules of orthography and sequential processing.* Thesis submitted to University of Rochester, Rochester.

Rajani, S. (2005). *Cross language priming in Bilingual Aphasics.* An unpublished Dissertation submitted to the University of Mysore.

Rajapurohit, B. B. (1982). *Acoustic characteristics of Kannada* (Vol. 27).Central Institute of Indian Languages.

Rastle, K., &Coltheart, M. (2006). Is there serial processing in the reading system; and are there local representations. *From inkmarks to ideas: Current issues in lexical processing*, 3-24.

Reicher, G. M. (1969). Perceptual recognition as a function of meaningfulness of stimulus material. *Journal of experimental psychology*, *81*(2), 275-280.

Rubenstein, H., Lewis, S. S., & Rubenstein, M. A. (1971).Evidence for phonemic recoding in visual word recognition. *Journal of Verbal Learning and Verbal Behavior*, *10*(6), 645-657.

Schoonbaert, S., Holcomb, P. J., Grainger, J., & Hartsuiker, R. J. (2011).Testing asymmetries in noncognate translation priming: Evidence from RTs and ERPs. *Psychophysiology*, *48*(1), 74-81.

Schvaneveldt, R. W., Meyer, D. E., & Becker, C. A. (1976).Lexical ambiguity, semantic context, and visual word recognition. *Journal of experimental psychology: Human perception and performance*, *2*(2), 243.

Schwanenflugel, P. J., & Rey, M. (1986). Interlingual semantic facilitation: Evidence for a common representational system in the bilingual lexicon. *Journal of Memory and Language*, *25*(5), 605-618.

Seidenberg, M. S., & McClelland, J. L. (1989).A distributed, developmental model of word recognition and naming. *Psychological review*, *96*(4), 523.

Shelton, J. R., & Martin, R. C. (1992). How semantic is automatic semantic priming?. *Journal of Experimental Psychology: Learning, memory, and cognition*, *18*(6), 1191.

Shrilekha, B., & Prema, K. S. (2015). *Lexical retrieval in normal healthy bilingual adults*. Master's dissertation submitted to University of Mysore, Mysore

Singhi, P., Kumar, M., Malhi, P., & Kumar, R. (2007). Utility of the WHO Ten Questions screen for disability detection in a rural community—the north Indian experience. *Journal of tropical pediatrics*, *53*(6), 383-387.

Smith, E. E., & Spoehr, K. T. (1974). The perception of printed English: A theoretical perspective. *Human information processing: Tutorials in performance and cognition. Hillsdale, NJ: Erlbaum*.

Snellen, H. (1862). *Test-types for the determination of the acuteness of vision*. PW van de Weijer.

Stanners, R. F., & Forbach, G. B. (1973). Analysis of letter strings in word recognition. *Journal of Experimental Psychology*, *98*(1), 31.

Tainturier, M. J., & Rapp, B. (2001).The spelling process. *The handbook of cognitive neuropsychology: What deficits reveal about the human mind*, 263-289.

Theios, J., & Muise, J. G. (1977). The word identification process in reading. *Cognitive theory*, *2*, 289-321.

Tzelgov, J., & Eben-Ezra, S. (1992). Components of the between-language semantic priming effect. *European Journal of Cognitive Psychology*, *4*(4), 253-272.

Van Heuven, W. J., Dijkstra, T., & Grainger, J. (1998).Orthographic neighborhood effects in bilingual word recognition. *Journal of memory and language*, *39*(3), 458-483.

Van Orden, G. C., Pennington, B. F., & Stone, G. O. (1990).Word identification in reading and the promise of subsymbolic psycholinguistics. *Psychological review*, *97*(4), 488.

Wheeler, D. D. (1970). Processes in word recognition. *Cognitive Psychology*, *1*(1), 59-85.

Wurm, L. H. (1997). Auditory processing of prefixed English words is both continuous and decompositional. *Journal of memory and language*, *37*(3), 438-461.

Wurm, L. H., & Ross, S. E. (2001). Conditional root uniqueness points: Psychological validity and perceptual consequences. *Journal of Memory and Language*, *45*(1), 39-57.

Zhao, X., Li, P., Liu, Y., Fang, X., & Shu, H. (2011). Cross-Language Priming in Chinese-English Bilinguals with Different Second Language Proficiency Levels. In *CogSci*.

Ziegler, J. C., & Goswami, U. (2006).Becoming literate in different languages: similar problems, different solutions. *Developmental science*, *9*(5), 429-436.