Nonword Repetition in Sequential and Simultaneous Bilinguals in Their First and Second Language

Jyothsna Mary Jacob

Register No: 11SLP012

A Dissertation Submitted in Part Fulfilment of Final Year
Master of Science (Speech-Language Pathology)
University of Mysore, Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MANASAGANGOTHRI, MYSORE – 570006
MAY 2013

CERTIFICATE

This is to certify that the dissertation entitled ***"Nonword repetition in sequential and simultaneous bilinguals in their first and second language"*** is the bonafide work submitted in part fulfillment for the degree of Master of Science (Speech-Language Pathology) of the student (Registration No.11SLP012). 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.

Mysore
May, 2013

Dr. S.R. Savithri
Director
All India Institute of Speech & Hearing
Manasagangothri, Mysore - 570006

CERTIFICATE

This is to certify that the dissertation entitled ***"Nonword repetition in sequential and simultaneous bilinguals in their first and second language"*** has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier in any other University for the award of any Diploma or Degree.

Mysore
May, 2013

Dr. Swapna N
Guide
Lecturer in Speech-Language Pathology
Department of Speech-Language Pathology
All India Institute of Speech and Hearing
Manasagangothri, Mysore

DECLARATION

This is to certify that this dissertation entitled ***"Nonword Repetition in Sequential and Simultaneous Bilinguals in Their First and Second Language"*** is the result of my own study under the guidance of Dr. Swapna. N, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier in any other university for the award of any diploma or degree.

Mysore **Register No.11SLP012**

May, 2013

DEDICATED

TO

ALMIGHTY
GOD

&

PARENTS

ACKNOWLEDGEMENTS

"I can do all things through Him who strengthens me." Philippians 4:13

*I thank my **Lord Jesus Christ** for giving me strength and courage all throughout my education and walking with me and strengthening me by saying 'My Grace is sufficient for you' in times of difficulty. Thank You Lord.......*

*I express my heartfelt gratitude to **Dr. Swapna N,** for her guidance, patience listening and support throughout this project. **Thank you Ma'am for bearing my silly mistakes and guiding me to the finer aspects of research in Speech-Language Pathology. Thank you Ma'am......***

*I would like to thank **Dr. S. R. Savithri, Director, AIISH, Mysore,** for permitting me to carry out this dissertation.*

*I express my sincere thanks to **Dr. Vasanthalakshmi** for helping me with statistical analysis. Thank You Ma'am.*

*My sincere thanks to **all the faculties** who has supported and guided me all throughout these four years.*

*Special Thanks to **Rev. Eppen Cherian,** the manager of St. Thomas school, the principal and **Ms. Joyce Lobo**, the St. Joseph school principal for giving me permission to do my data collection.*

***Dear Appa & Amma** words are not enough to express my affection and gratitude. **Appa,** I am thankful to you for guiding me and being a great support throughout my student life. Your words made me to come out from failure and your words brought success to my life. **Amma**, your two hour of praying brought a great success in my student life. Your love and prayers helped me to go through all the difficult situations....Whatever I am today, it's all because of you both...... love you alot....*

***Dear chechi,** it was nice growing up with someone like you – someone to lean on, someone to count on....someone to tell on! More than a sister you are my most beloved friend. Your guidance helped me a lot throughout this academic year.....**Dear Achacha,** I am blessed to have a loveable brother with great* *patience. I am thankful to God Almighty for making me your "baby"....Your prayers are more than anything to me.....*

***Dear Remya**, you have been one of my true loving friend who had always been there to support and rejoice me whenever there was slightest tension and counselled me to dissipate clouds of confusion. Thank you dear......*

***Dear Sneha**.......The Word Thanks is too less for all your support, help, love and patient listening.......you make up a prominent part of my sweet &wonderful life at AIISH..... Special thanks to you dear for the motivation and encouragement for learning driving and that made my data collection possible.*

***Shylaja di & Sangeetha**...Thank you for all the timely help by providing me with necessary resource materials and guidance.*

*Thank you **Soumya** for recording the stimuli for my study which was the first step towards its beginning.*

Special thanks to Reeny chechi for her patient listening and timely help with statistics.....

It is good to mingle with good people and good to learn from good people.
*In AIISH, the first name comes to my heart when I think of the words 'good and impartial 'is **PREETHI ma'am**.... Ma'am, you are a role model for me..... Thank u ma'am for all your support and guidance.....*

*Special thank to **Sreelachechi** for her support and co-operation.*

I express my heartfelt Thanks to Anitha, Mahernisa, Deepthi and Anisha for their timely help. My dear KUTTIES, thank you for sparing time for me.

*I express my sincere thanks to RAMYA, TANU, SETHU, VIJI, ANKITHA, VIJAITHA and EDNA for their support and help during stressed times.... Thank you **Angel corridormates** for giving me good memories.........*

*Very special thanks to **NAYANA** for making the last two years lively and for being a great friend.................. ☺*

I express my heartfelf thanks to all my participants for their cooperation.

TABLE OF CONTENTS

Chapter No.	Title	Page No.
	List of Tables…………………................................	i - ii
	List of Figures…………………...............................	iii
I	Introduction…………………………………………	1 - 10
II	Review of Literature………………………………..	11 - 43
III	Method…..…………………………………………..	44 - 51
IV	Results and Discussion………..………………...........	52 - 93
V	Summary and Conclusions……………………..........	94 - 100
	References…………………………………………..	101 - 118
	Appendix I……………………………………..........	iv - vii
	Appendix II….……………………………………...	viii - ix
	Appendix III………………………………………....	x - xi
	Appendix IV…….……………………………….........	xii – xiii
	Appendix V…….……………………………………	xiv - xv

LIST OF TABLES

Sl. No.	Title	Page No.
1.	Mean and standard deviation (SD) for the nonword repetition task for two groups (both males and females) in both languages.	55
2.	Main effect and interaction effect among the different variables.	56
3.	Mean and standard deviation (SD) values obtained on the Kannada and English NWR task in both the groups.	57
4.	Mean percentage of accuracy for nonwords across groups and languages.	64
5.	Main effect and interaction effect among the different variables.	65
6.	Comparison of overall scores based on syllable length across languages in each group.	68
7.	Results of repeated measures ANOVA across syllable length in each language and group.	69
8.	Mean and standard deviation (SD) for PVC at each syllable length across groups and languages.	72

9.	Main effect and interaction effect among variables	74
10.	Pairwise comparison of PVC between Kannada and English NWR task	77
11.	Mean and standard deviation (SD) for PCC at each syllable length across groups in both languages	79
12.	Main effect and interaction effect among variable for PCC	81
13.	Pairwise comparison of PCC between Kannada and English	83
14.	Mean, Median and standard deviation (SD) values for the errors at each syllable length	85
15.	Results of Mann-Whitney test for PSS at each syllable length across group and gender	87
16.	Pair wise comparison across languages at different syllable length	88
17.	Mean and standard deviation (SD) for the scores obtained on English and Kannada language test across groups	89

LIST OF FIGURES

Sl. No.	Title	Page No.
1.	Comparison of the simultaneous and sequential bilingual groups on the Kannada and English NWR task	58
2.	Comparison of overall scores for accuracy in each group across languages	59
3.	Mean correct scores on NWR task obtained for simultaneous and sequential bilinguals in males and females	61
4.	Mean percentage of correctness across group, language and gender	67
5.	Mean PVC across group, language and different syllable length	73
6.	Mean PCC across group, language and different syllable length	80
7.	Percentage of syllable substitution across group, language and syllable length	86
8.	Mean of language score across language and group	90

CHAPTER I

INTRODUCTION

Language and cognition are terms which are inevitable in the field of speech-language pathology. Language is always believed to be offering a window which provides insights into the nature, structure and organization of thoughts and ideas which are cognitive functions. Existence of a strong relationship between emergence of language and the cognitive development in a child is proven and well documented in the literature.

Acquisition of the language is defined as the process by which humans acquire the capacity to perceive and comprehend language, as well as to produce and use words and sentences to communicate. Language acquisition usually refers to the first-language acquisition, which studies infants' acquisition of their native language. However due to globalization and other factors such as migration by their parents, schooling etc., children acquire another language other than the first language which is referred to as second language acquisition. When a child is competent in two languages, he or she will be called a bilingual.

According to Webster's dictionary (1961) a bilingual is a person 'having or using two languages habitually with the fluency characteristics of a native speaker' and bilingualism is 'the constant oral use of two languages'. In the popular view, being bilingual equals being able to speak two languages perfectly; this has also been the approach of Bloomfield (1933) who defines bilingualism as 'the native-like control of two languages'. However Grosjean (1998) asserts that a bilingual is someone who can function in each language according to given needs. This definition has been proposed keeping in view the fact that a child can acquire language in a variety of ways at different points of time in their life and the extent of exposure to a particular language and its use varies. Researchers have classified bilinguals on the basis of age of acquisition, proficiency level of languages, context in which learning takes place etc.

Consideration of the age of acquisition as a basis for categorization of bilinguals has given rise to several classifications from a developmental perspective. One such classification is simultaneous and successive bilingualism (Genesee, Hamers, Lambert, Mononen, Seitz, & Starck, 1978). If a child learns two languages at the same time, it is considered as simultaneous acquisition of two languages. The simultaneous acquisition occurs early in the childhood, before the linguistic foundations of language are in place. They are considered to be learning a second language prior to full grammatical development of the first, and therefore the two developing systems will interact more actively. If the child acquires one language, and having mastered that language, learns a second language that is termed as successive or sequential acquisition. In this case, the child has acquired basic command of the first language and then establishes grammar in the second language. McLaughlin (1978) set the cutoff point at three years of age for defining simultaneous and sequential bilinguals. The child who is introduced to second language after three years of age was considered as sequential.

Cognition, a higher mental function is affected by the process of learning one or more languages. There is a close interaction between children's cognitive capacity and the influence of language specific input right from the beginning of language development. Working memory is one aspect of cognition that has been emphasized in studying language related cognitive functions in bilinguals. Working memory shows a clear cut relationship with language acquisition on the basis of different sources of evidence. A component of working memory, called the phonological working memory (PWM) has been studied extensively by researchers. PWM refers to a process of receiving, analyzing and processing sound elements in language. Baddeley's (2000) model highlights the importance of PWM in learning new words whose unique phoneme sequence must be retained long enough to be assigned a semantic representation. Several other researchers have also emphasized the role of PWM in the learning of sounds of new words and thereby vocabulary learning and reading (Daneman & Carpenter, 1980; Bradley & Bryant, 1985; Gathercole, Willis, Emslie, & Baddeley,1992; Michas & Henry, 1994; Siegel, 1994; Bruck & Genesee, 1995; McBride-Chang, 1995; Swanson & Berninger, 1995; Gathercole, Hitch, Service, & Martin, 1997; Oakhill & Kyle, 2000; Gathercole & Alloway, 2004; Alloway, Gathercole, Adams, Willis, Eaglen, & Lamont 2005; Christoffels & de Groot, 2005; Gathercole, Alloway, Willis, & Adams, 2006; Messer, Leseman, Boom, & Mayo, 2010; Windsor, Kohnert, Lobitz, & Pham, 2010)

PWM mechanism underlying language learning in children is most commonly assessed using a nonword repetition task. In this task, the children are instructed to repeat increasingly longer nonwords comprising of syllables that conform to the phonotactic constraints of the target language. The underlying mechanisms employed to repeat nonwords includes phonological processing (Bowey, 1996, 1997), articulation skills, speech perception (Frisch, Large, & Pisoni, 2000) and phonological short-term memory (Gathercole, Willis, & Emslie, 1992; Masoura & Gathercole, 2005; Gathercole 2006).

Baddeley's (1986) model of working memory provides a useful framework for thinking about the phonological short term memory mechanisms that contribute to NWR. The most recent version of the model (Baddeley, 2000) includes three important components of fluid memory. Two slave systems, the phonological loop and the visual-spatial sketchpad which are controlled by a central executive. The phonological loop holds auditory information for a brief period of time and includes a method of rehearsal to retain that information for longer periods. The central executive controls the use of slave components through attention and inhibition. This model of working memory also includes crystallized memory systems that store long term information including language knowledge. The phonological loop interacts with long term language knowledge in a reciprocal relationship. Repeating nonwords uses both of these. In the phonological loop, phonological working memory holds sound segments and they are rehearsed to facilitate repetition. Long-term language knowledge is activated when sound segments resemble lexical representations. Phonotactic rules of a language may additionally mediate the repetition of nonwords because retention and recall processes rely, in part, on rapid activation of well-specified phonotactic knowledge. Baddeley (2003) stated that the immediate recall of nonmeaningful phonological sequence as in the nonword repetition depends heavily on the children's ability to perceive, store, recall and reproduce accurately the strings of phonological sequences.

Repetition is considered to be a simple task that even young preschool children can understand. It provides information about children's linguistic processing and representations. According to Gathercole and Baddely (1996) the nonword repetition (NWR) test is found to be useful as a screening tool because of the lesser administration time involved compared to other measures. Moreover, it is reported that nonword repetition is culturally unbiased and is unrelated to maternal education level (Alloway, Gathercole, Willis, & Adams, 2004), or race (Campbell, Dollaghan, Needleman, & Janosky, 1997), are independent of intelligence quotient (Ellis Weismer, Tomblin, Zhang, Buckwalter, Chynoweth, & Jones, 2000; Conti-Ramsden, Botting, & Faragher, 2001), culture (Dollaghan & Campbell, 1998; Burt, Holm, & Dodd, 1999; Ellis Weismer et al., 2000), and gender (Burt et al., 1999). Difficulty in nonword repetition was found to increase as a function of nonword length in syllable and across a number of languages (Simkin & Conti-Ramsden, 2001; Bortolini, Aref, Caselli, Degasperi, Devy, & Leonard, 2006; Radeborg, Barthelom, Sjoberg, & Sahlen, 2006; Gathercole, 2006; Gijsel, Bosman, & Verhoeven, 2006; Klein, Watkins, Zatorre, & Milner, 2006; & Girbau & Schwartz, 2007).

Simultaneous and sequential bilinguals could be different in many ways with regard to the extent of the knowledge acquired in each of their languages which consequently could have an influence on their cognitive capacities. There are different views that exist with regard to the strength of the phonological representation in each of the language that the children acquire. Children who are actively engaged in learning two languages might develop particularly strong phonological representation, storage, and retrieval systems as a by-product of requirements for bilingual language learning and use (Bialystok, Majumder, & Martin, 2003). On the other hand, because the input in each language is necessarily distributed across their languages, they may develop relatively weaker representations in both their languages (Gollan, Forster, & Frost, 1997). This also may influence the cognitive processes especially the PWM.

Several studies have been carried out to assess the PWM using a NWR task in monolingual and bilingual population. Initially the research was focused on investigating the PWM of bilinguals in their native language. Papagno and Vallar (1995) found that the Italian polyglots were significantly better at nonword repetition and auditory digit span tasks in their native language than the nonpolyglots. Lee, Kim, and Yim (2013) studied the performance of monolingual and sequential bilingual children with native language as Korean on a Korean nonword repetition task. The results showed no difference between both the groups and authors supported the results by suggesting the possibility of the influence of language structure of the native language on the nonword repetition performance.

However over a period of time, the researchers have realized the need to test the PWM in both the languages as the bilinguals could have varying levels of exposure and experience in each language, as a result of which they could have varying levels of language knowledge. Consequently this could result in unique relationship between the cognitive processes underlying language learning such as phonological short term memory and levels of language knowledge. Moreover the current literature evidence highlights that the language structure plays an important role in determining the phonological processing skills. This speculation prompted the researchers to investigate the PWM in both the languages of the bilingual children. Lee, Kim, and Yim (2013) also emphasized on the importance of assessing the performance in both first and second language. Most of such studies have been carried out on sequential bilinguals.

Masoura and Gathercole (1999) studied the connection between phonological short-term memory and L2 (second language) vocabulary and between L1 (first language) and L2 vocabulary knowledge with Greek children learning English as L2 in school. Phonological short-term memory was assessed in both L1 and L2 by the nonword repetition task. The results showed that L2 nonwords were repeated less successfully and there was a significant link between phonological short-term memory and vocabulary. It was also found that language knowledge in one language was related to nonword repetition in that language, and that a more general nonword repetition capacity was connected to L2 but not L1

Gutierrez-Clellen and Simon-Cereijido (2010) evaluated the clinical utility of nonword repetition task with a sample of Spanish-English bilingual children and determined the extent to which individual differences in relative language skills had an effect on the clinical differentiation of these children by the measures. The results revealed that the clinical accuracy of nonword repetition tasks varied depending on the languages tested. Test performance appeared related to the individual difference in language use and exposure.

Summers, Bohman, Gillam, Penta, and Bedore (2010) carried out a study using nonword repetition task to investigate the performance of sixty two sequential bilinguals with Spanish as native language and English as second language. The results showed that the children produced Spanish like nonwords accurately than the English like nonwords. Nonword repetition performance in English and Spanish was also significantly correlated to language experience.

The results of the study by Parra, Hoff, and Core (2011) and Miettien (2012) also showed language-specific benefits of language exposure to phonological memory skill and of language-specific benefits of phonological memory skill to language development.

Attempts have also been made to explore the PWM in different types of bilinguals such as simultaneous and sequential bilinguals. This was keeping in view the fact that the pattern of language acquisition could possibly influence the PWM. Thorn and Gathercole (1999) compared the nonword repetition abilities of English-French simultaneous and sequential bilingual children. The investigators administered the French nonword repetition and English nonword repetition task on both the groups. The results indicated that the children's short-term memory performance in each language mirrored their familiarity with English and French, with greater vocabulary knowledge being associated with higher levels of recall of both words and nonwords in that language.

A study done by Shylaja, Abraham, Thomas, and Swapna (2011) compared the nonword repetition abilities of eight simultaneous and sequential Kannada-English bilinguals in the age range of seven to eight years. However the nonwords repetition task was administered only in their native language. The result indicated better phonological working memory skill in sequential bilinguals compared to simultaneous bilinguals which could be attributed to the age of acquisition effects of the second language and also on the amount of exposure and the use of first and second language.

Need for the study

A look into the literature reveals studies that employed a NWR task to assess PWM in the native language of bilinguals. However, due to differences in language structure and the pattern of acquisition in different types of bilinguals, studies have focused on investigating the PWM in the first and second language of the bilinguals i.e., to investigate the language specific knowledge and phonological working memory. These studies in general revealed better PWM in the language with greater vocabulary. The age of second language acquisition and the amount of exposure and use of the first and second language could have an impact on the performance on such tasks. Very few studies have also compared between the different types of bilinguals.

Such studies are limited in the Indian context too. India being a multicultural and multilingual country, there are chances of varying language exposure (first language and second language) and use of language and thereby children may have different levels of competency in the two languages even when acquisition is simultaneous or sequential. Further such studies comparing the simultaneous and sequential bilinguals on their phonological working memory in both their languages are limited even in India. There is a need for such studies considering the fact that bilingualism is the norm for the majority of people in the India. Further, this study could throw light on the relationship between proficiency of language and phonological working memory in both types of bilinguals.

The study can also have implications in the assessment and intervention of children with communication disorders. Currently the clinical utility of a bilingual approach to the assessment of PWM using nonword repetition has increased compared to a monolingual approach. There is a need for understanding whether the phonological working memory has to be assessed in both the languages of the bilingual children. The findings of the study could also assist clinicians in designing accurate screening procedures to assess PWM in one/both languages. With regard to the intervention, incorporating activities in both languages may promote better phonological working memory abilities. Keeping this in view, the current study was designed to explore the relationship between language experience, knowledge and phonological working memory skills in children with varying language experiences.

Aim of the study

The main aim of the present study was to compare the phonological working memory of seven to eight year old sequential and simultaneous Kannada-English bilingual children in their first and second language using a nonword repetition task. The specific objectives of the study were the following:

- To compare the overall accuracy of performance of simultaneous and sequential bilingual children in the first and second language nonword repetition task.
- To compare the accuracy of first and second language nonword repetition skills with respect to syllable length in simultaneous and sequential bilingual children.
- To compare the percentage of vowels correct in their first and second language based on syllable length in both the groups of children.
- To compare percentage of consonants correct in their first and second language in both groups of children.
- To compare the percentage of substitution, omission and addition errors during the production of first and second language nonwords based on syllable length in simultaneous and sequential bilingual children.
- To look for gender differences, if any, in the nonword repetition task in both the languages.

CHAPTER II

REVIEW OF LITERATURE

Bilingualism can be defined as “knowing” two languages (Valdez & Figueora, 1994). Bloomfield (1933) defined a bilingual as a person who has full fluency in two languages. However it was observed that some bilinguals were highly proficient in both the languages they speak, while other bilinguals clearly had a dominant or preferred language. Therefore, it became important to consider varying degrees of bilingualism to define and classify bilinguals. Grosjean (1998) therefore placed less emphasis on proficiency, and defined bilingualism as the ‘regular use of two languages in those people who need to use two languages in their everyday lives’, which would exclude those people who use their second language only infrequently. The current view is that a bilingual is someone who can function in each language according to the given needs.

Currently there are two classification systems with regard to bilingualism. Bilinguals are classified in different ways depending on the way in which the two languages are learned. Weinreich (1953) had proposed a classification based on the age of acquisition, proficiency and context of development. Based on the *age of acquisition*, bilinguals were divided into early bilinguals and late bilinguals. The early bilinguals were the ones who learn two languages early in the childhood before the age of six. These bilinguals were further identified as simultaneous and sequential bilinguals. If a child learnt two languages at the same time, it was considered as simultaneous acquisition of two languages. The simultaneous acquisition occurs early in the childhood, before the linguistic foundations of language are in place. They are considered to be learning a second language prior to full grammatical development of the first, and therefore the two developing systems interact more actively. If the child acquired one language, and having mastered that language, learnt a second language that was termed as successive or sequential acquisition. In this case, the child has acquired basic command of the first language and then established grammar in the second language. Sequential bilinguals here refer to the early sequential bilinguals. Early sequential bilinguals form the largest group worldwide and the number is increasing, particularly in countries with large immigration rate. The late sequential bilinguals were those who learn a second language after adolescence (Pena & Bedore, 2010). One problem when speaking about the simultaneous acquisition of two languages is defining a cutoff point at which one language can be said to have been established. McLaughlin (1978) set the cutoff point at three years of age. The child was introduced to second language after three years of age was considered as sequential.

Based on the *context of development* bilingualism was divided into three types which included compound, coordinate and subordinate bilingualism. Compound bilingualism is defined to have a common concept to which two languages are connected. They possess one semantic system for two linguistic codes. In coordinate bilingualism, first and second languages have separate conceptual structure and they learned these languages in two different contexts. They have two semantic systems and two linguistic codes. People who exhibit interference in his/her language by reducing pattern of the second language to those of the first are referred to as subordinate bilinguals. These bilinguals interpret words of their weaker language through the words of their stronger language.

Based on the *proficiency*, bilinguals were divided into balanced, dominant and passive bilinguals. A balanced bilingual refers to the person who masters the two languages roughly equivalently. Dominant bilingual is the one who has greater proficiency in one of his or her languages and use it significantly higher than the other language. A passive bilingual is the one who understands the second language, in either its spoken or its written form, or both, but does not necessarily speak or write it.

Proficiency in L1 (first language) is extremely important because the development of L1 and L2 (second language) are interdependent. Children who have attained a high level of skill at L1 are also likely to do so at L2, particularly on relative academic measures of language performance. This was explained by the interdependence hypothesis given by Cummins (1979). Interdependence hypothesis states that when the use of L1 is promoted by the environment where the child belongs, it helps the child in the acqusition of high level of second language proficiency. The L1 and L2 was believed to be the manifestation of a common underlying proficiency. It appears that bilingual children suffer no obvious linguistic disadvantages from learning two languages simultaneously (Snow, 1993). There might be some initial delay in learning the vocabulary items in one language, but this delay is soon made up, and of course the total bilingual vocabulary of the children is much greater.

When a child starts learning a new language apart from the first language, his/her cognitive resources clearly plays a role in the rapidity and success of acquisition of that language. Therefore the cognitive abilities of a child who is learning and learned a second language would be different from a child who has competency in only one language. Bilingualism was considered as a tool for assessing their cognitive abilities.

Cognition and its components

According to Neisser (1967) cognition refers to all mental processes, by which information is transformed, reduced, elaborated, stored, recovered and used. It includes cognitive processes such as perception, attention, pattern recognition, memory, organization of knowledge, language, reasoning, problem solving, classification, concepts and categorization (Best, 1999). All these cognitive processes are interrelated with one another rather than existing in isolation. One of the major components of cognition is memory. Memory is described as a process whereby what is experienced or learned is established as a record in the central nervous system (registration), where it persists with variable degree of permanence (retention) and can be recollected or retrieved from storage (recall) (Sadock, Sadock, & Pipino, 2007). Memory involves encoding of information, storing and retrieving of stored information. Memory storage can be divided into sensory memory, short term and long term memory. Another memory storage which is more complex than the short term memory and a component of the same is the working memory. Working memory can be defined as the ability to hold and manipulate information in the mind for a short period of time, and can be understood as a flexible mental workspace in which one is are able to temporarily store important information in the course of performing complex mental activities. Working memory storage system temporarily maintains mental representations that are relevant to the performance of a cognitive task in an activated state. Working memory also includes executive attention which is to control the mental representations held in short term or active memory.

Baddeley (1986, 2000) proposed a working memory model which consists of four components, namely the central executive, the phonological loop, the visuo-spatial sketchpad and the episodic buffer.

Central executive: According to Baddeley, Emslie, Kolodny, and Duncan (1998), the central executive (an attentional control system) is the working memory component responsible for controlling resources and monitoring information processing across informational domains. These include a range of regulatory functions including the retrieval of information from long-term memory, regulation of information within working memory, attentional control of both encoding and retrieval strategies, and task shifting (Baddeley, 1986), and is thus associated with a variety of high-level abilities, including language and reading comprehension in both children and adults (Gathercole & Pickering, 2000). The central executive coordinates the functions of the phonological loop and the visuo-spatial sketchpad, which mediate the storage of information.

Phonological loop: The first slave system to the central executive of working memory is the phonological loop, which is probably the best developed component of the working memory model (Baddeley, 2000), and is assumed to have developed on the basis of processes initially evolved for speech perception and production. It is understood to comprise a short-term, limited capacity phonological store that is capable of holding speech-based information, that is speech perception, and an articulatory control or rehearsal process based on inner speech, that is speech production. Memory traces within the phonological store are thought to fade and become irretrievable after about one-and-a-half to two seconds, but this decay of representations in the store can be offset by a serial subvocal rehearsal process, and can be refreshed by reading off the trace into the articulatory control process, which then feeds it back into the store (hence the name feedback loop, from which the phonological loop - originally called the feedback loop - gets its name). This is the process underlying subvocal rehearsal. The articulatory control process is also capable of taking written or visual material, converting it into a phonological code, and registering it in the phonological store. Thus, the phonological loop plays an important role in learning to read (and hence phonological awareness), the comprehension of language and the acquisition of vocabulary (Baddeley, 1990). Store in the phonological loop is considered as phonological working memory (PWM) which is responsible for maintaining phonological information necessary for reading, in that it retains the words, phrases, or sentences while they are being processed, for brief periods in order that longer units of text can be comprehended. Reduced phonological storage capacity, inefficient rehearsal abilities, or both, can result in poor comprehension when sufficient amounts of incoming information cannot be immediately and readily retained in the phonological store for processing (Montgomery, 2000).

Visuo-spatial sketchpad: The second slave system to the central executive of working memory is the visuospatial sketchpad, which is responsible for setting up and manipulating visuospatial images over brief periods, and plays a key role in the generation and manipulation of mental images (Baddeley, 2000). It is generally accepted that the sketchpad can be fractionated into two components, one visual and one spatial (Logie, 1995). According to Gathercole (1996), it is probable that the sketchpad is a relatively complex, limited capacity system that involves the active utilization of parts of these two components, namely the temporary visual store and the temporary spatial store that have been identified as responsible for coding information about the identification of objects and their spatial location. The visual component, that is the visual cache, is a passive system that stores visual information and spatial locations in the form of static visual representations. Neuropsychological evidence supports this structural assumption of separate visual and spatial components to mental imagery, with different anatomical locations within the brain responsible for each (Gathercole, 1996). These stores, like the phonological loop, can be fed to long-term memory via the episodic buffer, either directly through perception, or indirectly, through the generation of a visual image. The central executive, in addition to coordinating the functions of the phonological loop and visuo-spatial sketchpad, is assumed to control the episodic buffer (Baddeley, 2000).

Episodic buffer: According to Baddeley (2000), the addition of the episodic buffer to the above model allows for the integration of information from a variety of sources. It is assumed to be a limited-capacity, temporary storage system controlled by the central executive. It is episodic in the sense that it holds episodes or information that have been bound from a number of sources where information is integrated across space and potentially extended across time. It is a buffer, in that it is assumed to be capable of storing information in a multi-dimensional (visual or phonological) code, providing a temporary interface between the slave systems and long term memory. Although the episodic buffer is isolated from long-term memory, it represents a 'crystallized' cognitive system capable of accumulating long-term stored knowledge, which is an important stage in long-term learning.

This model highlights importance of PWM in the learning of new words whose unique phoneme sequence must be retained long enough to be assigned a semantic representation. Poor phonological working memory capacity would affect acquisition of new words and broader levels of language processing such as sentence comprehension that require the manipulation of phonological information. Therefore the linguistic knowledge and phonological working memory work together and deficits at the phonological working memory might produce difficulties in comprehension and learning of language as the child is not able recall the information of sounds in a word.

Assessment of the Phonological Working Memory

Nonwords are found to be a better measure to assess the phonological working memory capacity in both children and adults. NWR task involves the ability to immediately repeat heard nonsense words and involves various underlying processes including speech perception, lexical phonological knowledge, motor planning and articulation (Coady & Evans, 2007). It is one of the most frequently used phonological memory tasks. The NWR task is considered a relatively pure measure of phonological memory capacity because participants must retain the phonological representations of nonwords to accomplish the task, without being able to rely on lexical information to support repetition performance (Gathercole & Baddeley, 1989). It is a good predictor of language learning ability in children (Gathercole & Baddeley, 1990), adults (Vallar & Baddeley, 1984), and L2 learners (Service, 1992). Children who are better able to repeat nonwords after a single presentation tend to score higher on standardized vocabulary measures. Nonwords are plausible i.e., they follow the rules of word formation of the language in that they do not contain illegal strings of letters. Nonwords are sometimes called pseudowords.

In a nonword repetition task, the children listens to a set of nonwords, temporarily stores the novel phonological representation, and then produces it. This task involves the phonological loop which is a specialized subsystem of working memory with two components (Baddeley, 1986, 1996 & 2003). The first component is the phonological short-term storage which maintains the incoming auditory sequence as a phonological code and the second component is the subvocal rehearsal which holds this phonological representation avoiding its decay.

NWR task is proposed to have many advantages over the other speech and language tests. They are culturally unbiased in that it is unrelated to maternal education level (Alloway, Gathercole, Willis, & Adams, 2004), or race (Campbell, Dollaghan, Needleman, & Janosky, 1997), are independent of intelligence quotient (Conti-Ramsden, Botting, & Faragher, 2001; Ellis Weismer, Tomblin, Zhang, Buckwalter, Chynoweth, & Jones, 2000), & gender (Burt, Holm, & Dodd, 1999). It has gained a great deal of acceptance in the recent years as it correlates so well with standardized vocabulary measures in typical populations. Further NWR test has been found to be a useful screening test in children with language impairment, which requires a shorter administration time than other language measures (Gathercole & Baddeley, 1996).

Some of the factors such as word likeness, process of construction of nonwords etc. do play role in influencing the results of the experiment. According to Gathercole (1995) word likeness of nonwords to have a positive influence on the relationship, whereas Dollaghan, Biber, and Campbell (1993) stated that both lexical and non-lexical morphemes integrated into nonwords have an effect on the results of a nonword test because of the inevitable use of existing lexical information in repeating nonwords.

Role of PWM in language learning

Even though nonword repetition tests have been used to examine various operations that take place in phonological working memory, this task is commonly employed in studying the relationship between phonological working memory and different aspects of language learning. Gathercole, Willis, Emslie, and Baddeley (1991) proposed a significant correlation between nonword repetition results and vocabulary knowledge because both draw on phonological working memory capacity. An alternative explanation is that good vocabulary knowledge aids in nonword repetition. Gathercole, Willis, Emslie, and Baddeley (1992) conducted a longitudinal study to explore the nature of the developmental association between phonological memory and vocabulary knowledge. They administered measures of vocabulary, phonological memory, nonverbal intelligence, and reading in eighty children with normal language over a period of four years (at 4, 5, 6, and 8years of age). Comparisons of cross-lagged partial correlations revealed a significant shift in the causal underpinnings of the relationship between phonological memory and vocabulary development before and after 5 yrs of age. They reported that between 4 and 5 years, phonological memory skills appeared to exert a direct causal influence on vocabulary acquisition. Subsequently they concluded that, though, vocabulary knowledge became the major pacemaker in the developmental relationship, with the earlier influence of phonological memory on vocabulary development subsiding to a nonsignificant level.

Early researchers focused on finding out whether phonological memory abilities can be used to predict vocabulary learning. Gathercole, Willis, Emslie, and Baddeley (1992) found a relationship between phonological memory skills and vocabulary knowledge, which appeared to be reciprocal. Michas and Henry (1994) were also able to show that phonological memory measures predict new word learning ability. They introduced a vocabulary learning task to study the relationship between phonological working memory and the participants' ability to learn vocabulary items. Adams and Gathercole (1995) studied the relationship between phonological memory and spoken language development in thirty eight children with normal language skills in the age range of 2.10-3.1years. The children were grouped into high- and low-phonological memory groups. They found that children in the high-phonological memory group (i.e., with better nonword repetition ability) produced longer, more grammatically complex sentences compared to the group with poorer nonword repetition abilities.

Service and collaborators in Finland, studying Finnish children learning English as a foreign language in secondary school, has also shown that nonword repetition ability is an extremely good predictor of a child's capacity to acquire foreign vocabulary (Service, 1992; Service & Kohonen, 1995).

Gathercole, Hitch, Service, and Martin (1997) examined sixty, five year old children on four experimental tasks of word learning that varied systematically in the amounts of phonological and nonphonological learning required. Tasks selected were sensitive to measure phonological memory (digit span and nonword repetition), vocabulary knowledge, and nonverbal ability. Learning of the sound structures of new words was significantly, and to some degree independently, associated with aspects of both phonological memory skill and vocabulary knowledge. Learning of pairs of familiar words was linked with current vocabulary knowledge, although not with phonological memory scores. The findings suggested that both existing lexical knowledge and phonological short-term memory play significant roles in the long-term learning of the sounds of new words. The study also provides evidence of both shared and distinct processes contributing to nonword repetition and digit span tasks.

According to Baddeley, Gathercole, and Papagno (1998) phonological working memory functions as a gateway for storing linguistic knowledge into long-term memory. It is therefore considered not only as an essential part of language learning but also a potential source of individual differences in language learning. Working memory (WM) plays a crucial role in learning a second language (L2). The ability to repeat words in an unknown language has been observed to predict success in learning that language (Ardilla, 2003).

Gathercole (1999) tested 65 children with normal language in 5.1-6.3yrs of age and sixty adolescents with normal language aged 13.4-14.5yrs to study the relationship between phonological memory and vocabulary in older adolescents. They concluded that the link between phonological memory and vocabulary continues into adolescence. Adams and Gathercole (2000) examined the role of phonological working memory on grammatical complexity. They studied two groups of fifteen children with normal language aged 4.6 to 5.0years matched on nonverbal IQ, but differing in nonword repetition ability. Results revealed that children in the higher nonword repetition ability produced more grammatically complex sentences using a wider variety of lexical items compared to the children with lower nonword repetition abilities. Gathercole (2006) found that children having better phonological memory skills acquire vocabulary more rapidly than children having less phonological memory skills

Kaushanskaya, Blumenfeld, and Marian (2011) conducted a study to compare bilingual and monolingual adults on their native-language vocabulary performance and also examined the relationship between short-term memory skills and vocabulary performance in monolinguals and bilinguals. In the first experiment, English-speaking monolingual adults and simultaneous English-Spanish bilingual adults were administered measures of receptive English vocabulary and of phonological short-term memory. In the second experiment, monolingual adults were compared to sequential English-Spanish bilinguals, and were administered the same measures as in first experiment, as well as a measure of expressive English vocabulary. Analyses revealed comparable levels of performance on the vocabulary and the short-term memory measures in the monolingual and the bilingual groups across both experiments. There was a stronger effect of digit-span in the bilingual group than in the monolingual group, with high-span bilinguals outperforming low-span bilinguals on vocabulary measures. Results obtained indicated that bilingual speakers may rely on short-term memory resources to support word retrieval in their native language more than monolingual speakers.

Recent research with adults has shown that early exposure to two languages may facilitate the acquisition of novel words (Kaushanskaya & Marian, 2009).The existence of this bilingual advantage has not been examined in bilinguals with less proficiency. In a paper presented at International Conference on Bilingualism and Comparative Linguistics, Nair, Mathew, Bhat, and Demuth, (2012) report the findings of a novel word learning task comparing monolinguals with a group of low and high proficient Tamil - English bilinguals who differed in their language learning histories and exposure to a second language. Sixty Tamil monolinguals and Tamil - English bilinguals in the age range of 18 - 25 were selected as participants. Linguistic proficiency was examined by using a language proficiency rating scale. Since word learning has found to be correlated with phonological working memory (Gupta, 2003), a set of non-word repetition tasks was also administered to all participants. This was followed by a novel word learning task. The novel words were real words in Hindi, a language which participants were unfamiliar with. Ten novel words were presented via head phones as the visual referents were shown simultaneously on a computer monitor. Participants were asked to repeat each novel word aloud three times. Participants were then tested immediately for their retention of these novel words by using identification and a naming task. The results showed a significant difference in identification and naming of the novel words, with high proficient bilinguals outperforming the less proficient bilinguals. However, the less proficient bilinguals also outperformed monolinguals in both the identification and naming tasks, suggesting a bilingual advantage even with limited proficiency. Interestingly, performance on the non-word repetition task did not differ for monolinguals or bilinguals, failing to establish a direct link between phonological working memory and word learning ability. This suggests that bilinguals with different language histories respond differently to novel word learning; even limited exposure to a second language can contribute some amount of word learning advantage.

Phonological memory is necessary for performing complex linguistic tasks in both the first language (L1) and the second language (L2) (Christoffels & de Groot, 2005) including auditory language comprehension (Smith, Mann, & Shankweiler, 1986) and written language processing (Daneman & Carpenter, 1980; Swanson & Berninger, 1995). The storage capacity of the phonological memory system is limited, and human beings can maintain only a few items in memory at any one time. It is well documented in literature that bilinguals having lower language proficiency in L2 compared to L1 proficiency of the monolingual peer show lowered phonological memory performance (Messer, Leseman, Boom, & Mayo, 2010; Windsor, Kohnert, Lobitz, & Pham, 2010).

Phonological working memory and general cognitive abilities were identified as strong predictors of phonological awareness (McBridge-Chang, 1995; Oakhill & Kyle, 2000). As a component of phonological awareness, working memory is an essential part of reading and the acquisition of literacy (Bradley & Bryant, 1985; Gathercole & Alloway, 2004). Therefore greater the child's verbal memory capacity, the more readily the child will able to acquire new words, and establish long term memory representation of the sound structures of those words.

Bilingualism and Cognition

In the past bilingualism was believed to have a negative effect. Most of the monolinguists' believed that any deviation from monolingual standard will lead to cognitive deficits. Long and Harding- Esch (1977) suggested that the mental activities carried out through second language will be fractionally less efficient than in the first language. However some monolinguists viewed bilingualism in a positive direction. They believed that first language processing by second language user may become richer and their mental processing by second is more effective. By 1980s research on second language processing was widened and researchers try to explore the relationship between the memory especially short term memory and different components of second language.

According to Cummins (1976) the level of proficiency in two languages by bilingual children may be an important factor in determining the cognitive effects of bilingualism. This statement was supported and elaborated by the 'threshold hypothesis'. This hypothesis proposes that there may be threshold levels of linguistic proficiency that bilingual children must attain in order to avoid cognitive disadvantages and to allow the potentially beneficial aspects of becoming bilingual to influence the cognitive growth. This hypothesis also assumes that until the child has attained a certain minimum or threshold level of proficiency in both languages, there will not be long term effect of positive effects of bilingualism on cognitive growth. Earlier literature had proved that there is a rapid cognitive and academic progress for bilinguals who attained the upper threshold level of bilingual proficiency. Language acquisition context will have an effect the type of bilingualism attained, which in turn will strongly influence the long term effect consequences of that bilingualism for overall cognitive and linguistic functioning.

Several studies have investigated the influence of bilingualism on cognition. Bilingualism helps in improving cognitive flexibility and metalinguistic awareness (Pearl & Lambert, 1962; Ben-Zeev, 1977; Cook, 1997). Cummins and Gulustan (1974) found better performance by bilinguals compared to monolinguals on verbal and nonverbal ability measures and on verbal originality measure of divergent thinking. Ben-Zeev

(1977) compared Hebrew- English bilinguals, Hebrew monolinguals and English monolingual in the age range of five to eight years on IQ subtests of Wechsler Intelligence Scale for Children (WISC) such as similarities, digit span, picture completion and picture arrangement tasks. It was found that in spite of low vocabulary level, bilinguals showed more advanced processing of verbal material. Result of a study done by Kessler and Quinn (1987) also reports outperformance of bilingual children compared to monolingual children in the ability to form scientific hypothesis in problem solving and setting and on semantic and syntactic measures. This result indicated the enhanced cognitive and linguistic creativity in bilinguals related to their bilingual proficiency.

Ricciardili (1992) examined the relationship between bilingualism and cognitive development as predicted by threshold theory. Results of the study were consistent with the theoretical notion that there may be a level of linguistic proficiency which bilingual children attain in order to avoid cognitive deficits and to allow the cognitive benefits. Children with high degree of bilingualism showed bilingual superiority on cognitive task provided. Bilingual children tend to have better meta-linguistic skills than monolinguals (Bruck & Genesee, 1995; Lesaux & Siegel, 2003).

Fardeau (1993) investigated the relationship between bilingualism in children and cognitive development. French-Italian bilingual children (aged 7-11) were categorized into four groups: (1) equally fluent in both languages, acquired at home; (2) equally fluent in both languages, acquired scholastically; (3) dominant in French; & (4) dominant in Italian. A control group of monolingual Italian children was included. A series of cognitive tests was administered to the students and to the control group. It was concluded that bilingualism in early childhood exerts a positive effect on the formation of cognitive processes in children.

Bialystok (1999) assessed the cognitive complexity and attentional control in bilingual children. In order to assess cognitive complexity and control, the dimensional change card sort task and the moving word task was administered on a group of bilingual and monolingual children. The results revealed that the bilingual children were more advanced than the monolinguals in the solving of experimental problems requiring high levels of control.

Kormi-Nouri, Moniri, and Nilsson (2003) assessed the episodic and semantic memory in a group of bilingual and monolingual children. Episodic memory was assessed using the subject-performed tasks (with real or imaginary objects) and verbal tasks, with retrieval by both free recall and cued recall. Semantic memory was assessed by word fluency tests. The positive effect of bilingualism was found on both episodic memory and semantic memory**.** It was suggested that bilingual children could integrate and/or organize the information of two languages and so bilingualism creates advantages in terms of cognitive abilities (including memory).

Bialystok (2005) investigated the effect that bilingualism might have on specific cognitive processes rather than domains of skill development. Three cognitive domains were examined: concepts of quantity, task switching and concept formation, and theory of mind. The common finding in these disparate domains was that bilingual children were more advanced than monolinguals in solving problems requiring the inhibition of misleading information. She concluded that bilingualism accelerates the development of a general cognitive function concerned with attention and inhibition, and that facilitating effects of bilingualism were found on tasks and processes in which this function was most required.

Shabani and Sarem (2008) investigated the learning strategy use of monolinguals and bilinguals in approaching English as a foreign language. It was also an attempt to compare the strategy use of male and female bilinguals. For this purpose, 30 Persian-speaking monolinguals (15 males and 15 females) and 30 Kurdish-Persian speaking bilinguals (15 males and 15 females) were selected from among Iranian EFL learners studying English Literature at Ilam State and Azad universities. They were asked to fill out Oxford's (1980, 1990) the Strategy Inventory for Language Learning (SILL). 50-item version of SILL, used in this study, comprised of six parts: memory strategies (9 items), cognitive strategies (14 items), compensation strategies (6 items), metacognitive strategies (9 items), affective strategies (6 items), social strategies (6 items). The authors concluded that there was a significant difference between the strategy use of male and female Kurdish-Persian speaking bilinguals in favor of the male learners. Also, male bilinguals have used more memory, cognitive, and metacognitive strategies compared to the female bilinguals. But there was no significant difference between male and female bilinguals with regard to the compensation, affective and social strategy use.

Bialystok, Luck, and Craik (2008) did a study to produce comprehensive and integrated description of the ways in which bilingualism affects cognition and also to see the effect of aging on cognition across life span. There were twenty four young monolinguals and young bilinguals with the mean age of 20.7 years and twenty older monolinguals and bilinguals with mean age of 67.2 years who participated in the study. They were given working memory task, lexical access fluency task and executive task. Results showed similar performance by monolinguals and bilinguals for the working memory task, better performance by monolinguals on the lexical retrieval task and better performance by bilinguals on executive control task.

Bialystok (2009) investigated whether bilingual children showed an advantage in working memory. A group of seven year old monolinguals and bilinguals were compared on tasks such as sequencing span test, frog matrix task to assess temporal memory, faces and pictures task, and digit span tasks. In all the tasks, the bilinguals outperformed their monolingual peers which indicated bilingual children enjoy more advanced levels of working memory.

Bialystok and Viswanathan (2009) investigated three components of executive control: response suppression, inhibitory control, and cognitive flexibility. They used a behavioral version of an anti-saccade task, called the 'faces task' which was used to isolate the components of executive functioning responsible for previously reported differences between monolingual and bilingual children and to determine the generality of these differences by comparing bilinguals in two cultures. Ninety children, 8-years old, belonged to one of three groups: monolinguals in Canada, bilinguals in Canada, and bilinguals in India. The bilingual children in both settings were faster than monolinguals in conditions based on inhibitory control and cognitive flexibility but there was no significant difference between groups in response suppression or on a control condition that did not involve executive control. The children in the two bilingual groups performed equivalently to each other and differently from the monolinguals on all measures in which there were group differences, consistent with the interpretation that bilingualism is responsible for the enhanced executive control. These results contribute to understanding the mechanism responsible for the reported bilingual advantages by identifying the processes that are modified by bilingualism and establishing the generality of these findings across bilingual experiences.

Wodniecka, Craik, Luo, and Bialystok (2010) reported the effect of bilingualism on memory performance. Following previous reports of a bilingual advantage in executive control that sometimes shows a greater advantage in older adults, they compared younger and older monolinguals and bilinguals on a memory paradigm that yielded separate measures of familiarity and recollection. There were no consistent effects in familiarity, but there were age and language differences in recollection, a measure reflecting executive control. Younger adults were superior to older adults on this measure, but there was minimal support for a bilingual advantage in the younger group. Older bilingual adults did show such an advantage, especially on non-verbal tasks. The results provide some initial evidence for the interrelations among processing abilities, types of material, bilingualism, and aging in assessments of memory performance. Similar findings have also been reported by Bialystok and her colleagues. They have shown that early bilingualism and constant daily use of two or more languages leads to precocious development of certain cognitive processes for children, advantages that persist across the lifespan (Bialystok, Craik, Klein & Viswanathan, 2004; Bialystok, Craik & Ryan, 2006) (cited in Bialystok, 2001).

Carlson and Meltz (2008) did a study to assess the executive functioning in a group of native Spanish- English bilinguals, English monolinguals and English speakers enrolled in second language immersion kindergarten. Results showed that better performance by native bilingual children on executive functions than both other groups. Importantly, relative advantage was significant for tasks that appear to call for managing conflicting attentional demands.

An Indian study done by Stephen, Sindhupriya, Mathur and Swapna (2010) compared the cognitive linguistic performance in twelve bilingual and twelve monolingual children in the age group of 7- 8 years. These two groups of children were tested on three domains such as attention/ discrimination, memory and problem solving using the Cognitive Linguistic Assessment protocol for children (CLAP- C) developed by Anuroopa and Chengappa (2008). The result revealed that bilingual children performed superior to monolingual children on all the three cognitive linguistic domains.

Sangeetha and Swapna (2011) tried to examine the interaction between cognitive and linguistic mechanisms in simultaneous and sequential bilinguals using Cognitive Linguistic Assessment Protocol for children (CLAP- C). Ten Kannada – English simultaneous and sequential bilingual children in the age range of 7- 8 years participated in the study. The results showed superior performance on cognitive task by simultaneous bilinguals compared to sequential bilinguals which indicates simultaneous bilingual advantage on the cognitive processing. This study attributed the performance of simultaneous population to the age of acquisition and the extent to which the individual is bilingual.

Bilinguals, in other words, are superior to monolinguals in executive control of attention, although they are no different from monolinguals in their knowledge of the system. The consistent pattern is that bilingual children develop the ability to control attention and ignore misleading information earlier than monolinguals, even when the two groups are operating with the same basic knowledge of the domain. This dissociation is the basis for the claim that bilingualism has a specific impact on the development of executive processing but no effect on basic cognitive performance (Bialystok & Feng, 2009).

In summary, the research evidence suggests that bilingual acquisition involves a process that builds on an underlying base for both languages. There does not appear to be a competition over mental processes by the two languages leading to confusion or poor performance on various domains and there are possible cognitive advantages to bilingualism. It is evident that the duality of the languages per se does not hamper the overall language proficiency or cognitive development of bilingual children. Bilinguals can extend the range of meanings, associations and images, and think more fluently, flexibly, elaborately and creatively. Studies also showed that the bilinguals exhibit better memory, divergent thinking, and problem solving. These studies provide evidence that the experience of controlling attention to two languages boosts the development of executive control processes in childhood for bilinguals, sustains cognitive control advantages for bilinguals through adulthood and protects bilingual older adults from the decline of these processes with ageing. Learning of two languages affect cognition and in turn the PWM because of the characteristics of the language involved, age at which the languages are acquired, the context in which the language was acquired, and how the languages code a given aspect of the world.

Phonological working memory in bilinguals

Nonword repetition PWM has been widely investigated in bilinguals using a nonword repetition task. Most studies have compared the PWM in monolinguals and sequential bilinguals. Some of these studies have tested the bilinguals in their native language which have been described below.

Papagno and Vallar (1995) compared the Italian polyglots with the nonpolyglots. They were assessed on verbal (phonological) memory using nonword repetition and auditory digit span tasks as well as visuospatial short-term and long-term memory, general intelligence, and vocabulary knowledge in their native language (L1). They found that the polyglots had a superior level of performance in verbal short-term memory tasks (auditory digit span and nonword repetition) and in a paired-associate learning test, which assessed the subjects' ability to acquire new (Russian) words. A comparable level of performance was obtained in tasks assessing general intelligence, visuospatial short-term memory and learning, and paired-associate learning of Italian words for both the groups. The authors suggested a close relationship between the capacity of phonological memory and the acquisition of foreign languages.

Hoff and McKay (2005) did a study to test the hypothesis that phonological memory for English-like stimuli was less accurate in children acquiring English in bilingual environments than in English-learning monolingual children. Nine children from monolingual environment and nine children from bilingual environment with mean age of 23 months participated for the study. Non word repetition task was taken to measure the phonological memory skills. Even though generalization of the result was not possible, monolingual children performed better compared to bilingual. Vocabulary size was significantly related to real word repetition and marginally related nonword repetition.

Lee, Kim, and Yim (2013) studied the performance of monolingual and bilingual children on Korean nonword repetition task and checked for the relation between nonword repetition and vocabulary skills of these children. Monolingual children were native speakers of Korean language and bilinguals were Korean English sequential bilingual children of three to five years. Results showed no difference between both the groups and authors supported the results by suggesting the possibility of the influence of language structure of the native language consisting of small inventory of syllable shape on the nonword repetition performance. They also threw light on the importance of assessing performance in both first and second language. It was also found that children scored better for three syllable nonwords compared to two syllable nonwords. This finding was attributed to the concept of perceptual salience effect suggested by Bates and MacWhinney (1987) in which the two syllable length was too short to be perceived accurately. According to Alt (2010) and Majerus, Poncelet, Elsen, and Van der Linden (2006) short nonwords shows difficulty in initial phonological perception or encoding of phonological forms. Korean nonwords were found to be a predictive measure of language skills for linguistically diverse children. Results also showed significant correlation between the nonword performance and vocabulary skill. This study also suggested the importance of further research in finding out the relationship between amount of usage of both first and second language and also competency in both languages by bilingual children.

There are other studies which have been conducted to assess the bilinguals' PWM in both their first and their second language. Most of these studies have been carried out on the sequential bilinguals.

Masoura and Gathercole (1999) studied the connection between phonological short-term memory and L2 vocabulary and between L1 and L2 vocabulary knowledge with Greek children learning English as L2 in school. They used a productive and receptive Greek (L1) vocabulary task and two translation tasks to assess English (L2) vocabulary knowledge to assess language skills. Phonological short-term memory was assessed in both L1 and L2 by the nonword repetition task. The results showed that L2 nonwords were repeated less successfully, but also that there was a significant link between phonological short-term memory and vocabulary. Both L1 and L2 vocabulary scores correlated with both Greek and English nonword repetition test scores. Nonword repetition was linked to L2 vocabulary scores after partialling out L1 vocabulary. However, when L2 vocabulary scores were partialled out, L1 vocabulary was no longer associated with nonword repetition. This was taken as a sign of language specificity, not, however, in the sense that language knowledge in one language is related to nonword repetition in that language, but that a more general nonword repetition capacity is connected to L2 but not L1.

Gutierrez-Clellen and Simon-Cereijido (2010) evaluated the clinical utility of nonword repetition task with a sample of Spanish-English bilingual children and determined the extent to which individual differences in relative language skills had an effect on the clinical differentiation of these children by the measures. Ninety-five typically developing children and forty nine children with language impairment with a mean age of six years participated in the study. They were tested using each language. The results revealed that the clinical accuracy of nonword repetition tasks varied depending on the languages tested. Test performance appeared related to the individual difference in language use and exposure. The findings of their study does not support a monolingual approach to the assessment of bilingual children with nonword repetition tasks, even if children appear fluent speakers in the language of testing.

Summers, Bohman, Gillam, Penta, and Bedore (2010) conducted a study using nonword repetition task to investigate the performance of sixty two sequential bilingual children in the age range of 4.6 to 6.5 years with Spanish as native language and English as second language. They used Spanish like and English like items from the NWR tasks and also assessed the relationship between performance on NWR, semantics and morphology tasks in both the languages. The results showed that the children produced Spanish like nonwords accurately than the English like nonwords. Nonword repetition performance in English and Spanish was also significantly correlated to language experience. Language knowledge appeared to play a role in the task of NWR. The relationship between performance on morphosyntax and NWR tasks indicated that children rely on similar language-learning mechanisms to mediate these tasks. More exposure to Spanish increased the abilities to repeat longer nonwords. Further the NWR performance was significantly correlated to the cumulative language experience in both English and Spanish. Nonword repetition accuracy in both languages was found to be decreased as syllable length increased. This knowledge may shift across levels of bilingualism.

Parra, Hoff, and Core (2011) tried to explore the relation of phonological memory to language experience and development in sequential Spanish-English bilinguals. A nonword repetition task was administered. Phonological memory for English-like nonwords was highly correlated with that for Spanish-like nonwords, and each was related to vocabulary and grammar in both languages which suggested a language-general component to phonological memory skill. Results also showed language-specific benefits of language exposure to phonological memory skill and of language-specific benefits of phonological memory skill to language development.

A longitudinal study done by Abreu (2011) tested the hypothesis that bilinguals exhibit more efficient working memory abilities than monolinguals as there is a greater opportunity a bilingual environment provides to train cognitive control by combating interference and intrusions from the non-target language. One of the tasks provided to monolingual and bilingual children was repetition of nonsense words. The results revealed an influence of language experience on nonword repetition and monolinguals performed better compared to bilingual age matched children. He interpreted the results by suggesting that bilinguals have limited exposure to each language compared to complete exposure on one language by the monolingual children. Therefore bilingual children have weak underlying phonological representation of a target language.

Miettinen (2012) conducted a two year longitudinal study in which she investigated the connection between language knowledge and phonological working memory as understood in the working memory model by Baddeley (1986) and also tried to study the kind of relationship that exist between phonological working memory and second language. The study also examined a number of aspects generally associated with phonological working memory, including modality and language specificity. Fifteen Finnish children studying in third grade participated in nonword word repetition task in both Finnish (L1) and English (L2) languages. The findings suggested that the connection between English (L2) knowledge and phonological working memory as assessed with an English nonword repetition test was fairly strong. Furthermore, phonological working memory did not appear to be strictly language-specific as both nonword repetition tests (based on L1 and L2) were connected to L2 language measures.

Lee and Gorman (2012) examined the group difference between English nonword repetition in seven year old fifteen monolingual English, fifteen Korean-English bilingual, fifteen Chinese English bilingual and twelve Spanish-English bilingual children using English NWR task varying in syllable length. They also tried to examine the interrelation between nonword repetition accuracy, vocabulary, phonological awareness and phonotactic probability. The results suggested similar repetition accuracy for all the linguistic groups. All groups showed different correlation pattern among nonword repetition, vocabulary and phonological awareness and authors strongly suggested the importance of linguistic experience on nonword repetition task.

Yoo and Kaushanskaya (2012) compared the phonological working memory in monolinguals and bilinguals. The results revealed that for digit-span and nonword repetition tasks, monolinguals outperformed bilinguals at the easier levels of the tasks, but the differences between the two groups disappeared with the increase in the difficulty levels. The overall results suggested that the proficiency-based differences between monolingual and bilingual phonological memory performance depend on the degree to which the tasks rely on lexical-semantic knowledge and the difficulty level of the task.

Kaushanskaya and Yoo (2012) examined phonological short term memory and phonological working memory in Korean – English adult sequential bilinguals (mean age of 29.7 years). Phonological short-term memory (STM) was measured via a nonword repetition task, where participants repeated nonwords that increased in length. Phonological working memory was measured via a complex task, where the nonword repetition task was combined with an animacy judgment task. In general, bilinguals performed better on the short term memory task than on the working memory task, and with shorter nonwords than with longer nonwords. Results also revealed that L1 short term memory performance was superior to L2 short term memory performance, but only for the longest nonwords, whereas L1 working performance was superior to L2 working memory performance across all length levels. In addition, correlation analyses between bilinguals' L1 and L2 performance revealed stronger cross-linguistic associations for the working memory task than for the STM task. Together, the findings suggest that WM tasks may engage domain-general central executive processes in bilinguals, whereas STM skills may depend on language-specific knowledge in the L1 and the L2.

Considering the literature evidence on a positive relationship between language experience and structure and PWM abilities, current research efforts are towards developing and standardizing nonword repetition tests in different languages. Developing language specific nonword repetition tasks allows for the building and confirmation of relationship between nonword and language development in different languages.

Different types of bilinguals also have been compared using nonword repetition task to check for any difficulties in their PWM. Some of the studies have tested the PWM of children in their native language or in both their first and second language. Thorn and Gathercole (1999) compared the nonword repetition abilities of English-French bilingual children. The children who were aged between four and eight were classified as sequential (having acquired after they partly or completely acquired English as their native language) and simultaneous (having acquired English and French at the same time) bilinguals. The simultaneous bilingual children obtained a raw score of 100 on both French and English vocabulary skills, however the sequential bilingual children's vocabulary score was 113 for English and 75 for French as found on a questionnaire administered to parents. The investigators administered the French nonword repetition and English nonword repetition task on both the groups. Results indicated that the children's short-term memory performance in each language mirrored their familiarity with English and French, with greater vocabulary knowledge being associated with higher levels of recall of both words and nonwords in that language i.e., the simultaneous bilingual showed superior repetition of nonwords both in English and French, however the sequential bilinguals showed superior repetition of nonwords only in English. Interest on the monolingual- bilingual comparison in nonword repetition task in first, second and both languages continued till many years ahead.

A study done by Shylaja, Abraham, Thomas, and Swapna (2011) compared the nonword repetition abilities of eight simultaneous and sequential Kannada-English bilinguals within the age range of seven to eight years. The children were asked to repeat Kannada nonwords which differed in syllable length. Results were obtained for both accuracy of nonword repetition based on the length and errors made by the children. The overall results indicated better phonological working memory skill in sequential bilinguals compared to simultaneous bilinguals which can be attributed to the age of acquisition effects of the second language and also on the amount of exposure and the use of first and second language. Simultaneous bilinguals showed significant difficulty in repeating both the four and five syllabic nonwords, while the sequential bilingual children exhibited difficulty in repeating the five syllabic nonwords. Simultaneous bilinguals also produced more consonant and vowel errors compared to the sequential bilinguals. The errors were predominantly the syllable substitution errors rather than the additions or omission errors.

To sum, a look into the literature reveals the importance of assessment of cognition specifically the PWM in bilingual population, since PWM plays an important role in the acquisition of various components of a language and considered as the gateway for language learning. A number of recent studies highlight the bilingual advantage in the overall cognitive abilities especially the phonological working memory capacity. Some studies identified the language specific nature of phonological working memory capacity by administering NWR tests in both first and second language of the bilinguals. These results studies support the bilingual approach to assessment of PWM. These researchers also acknowledge the influence of other factors such as age of acquisition, use of language, language familiarity and similarity, amount of exposure etc. on the performance and on the NWR tests. The present scenario does not support a monolingual approach of assessment or intervention for a bilingual child or an individual. A few studies have also compared the different types of bilinguals such as simultaneous and sequential on NWR tasks. These studies have revealed contradictory findings which indicate that further research is warranted. Similar studies comparing sequential and simultaneous bilinguals in their native and second language in the Indian context are scarce.

Bilingualism research in a linguistically diverse country like India can lead us to a wide knowledge about how bilingualism behaves in culturally varied Indian children which in turn would help us find solutions in rehabilitating bilingual children with language impairment. Hence the present study was an attempt toward investigating the performance by sequential and simultaneous bilinguals in their first and second language on nonword repetition tasks, which is a widely accepted measure of phonological working memory. The present study also looks forward for outcomes which help us in understanding contributing factors that influences the performance of bilingual children in Indian context and cognitive linguistic organization at the central level in Indian bilingual children.

CHAPTER III

METHOD

The aim of the study was to compare the performances of sequential and simultaneous bilinguals on nonword repetition task in their first and second language. The method that follows provides the understanding about the participant selection, development of nonwords in Indian English language, other materials used, procedure and analysis of the samples obtained.

Participants: A total of forty four typically developing Kannada-English bilingual children in the age range of seven to eight years studying in different CBSE schools in Mysore with medium of instruction being English were selected for the study. All the participants considered were native speakers of Kannada* and they were divided into two groups depending on the age of acquisition of their second language which was English.

1. Group A consisted of twenty two simultaneous bilingual children (those who had acquired both Kannada and English simultaneously before three years of age). Eleven males and eleven females were considered in this group.

2. Group B consisted of twenty two sequential bilingual children (those who had acquired Kannada first and learned English once they joined school after three years of age). Eleven males and eleven females were considered in this group.

---

*Kannada is a Dravidian language spoken in the state of Karnataka located in the southern part of India.

Participant selection criteria: The criteria considered for selection of simultaneous and sequential bilinguals were the following:

1. No history of speech, language, sensory, neurological, developmental, academic and intellectual disorders, which was ensured using the 'WHO ten question disability screening checklist' (Singhi, Kumar, Malhi, & Kumar, 2007).
2. Age appropriate receptive and expressive language skills as revealed by standardized test of language viz. Linguistic Profile Test in Kannada (LPT, Karanth, Ahuja, Nagaraja, Pandit, & Shivasankar, 1991) a diagnostic language tool.
3. Participants belonging to middle to high socioeconomic status which was ensured using the NIMH socioeconomic status scale developed by Venkatesan (2011). The scale has sections on occupation and education of the parents, annual family income, property and percapita income. Participants who belonged to socioeconomic status of SES III to SES V (middle to upper class) in the various sections of the scale were considered for the study.

A minimal social proficiency score of two for sequential bilingual children and a score of three for simultaneous bilingual children in their second language on all the macro skills of the International Second Language Proficiency Rating Scale (ISLPR) (Ingram, 1985). The ISLPR scale was used to check the language proficiency in the second language, English in this study. ISLPR describes language performance at eight points along the continuum from zero to native like proficiency in each of the four macro skills (speaking, listening, reading and writing). The scale is divided into primary and secondary skills (speaking and listening). Parents and teachers handling the children were consulted in order get accurate information about the language proficiency.

A modified version of questionnaire developed by Harini and Chengappa (2010) (Appendix I) was administered on teachers and parents to identify the second language acquisition pattern of the selected children i.e. simultaneous and sequential bilinguals. Children exposed to both Kannada and English languages since birth were considered as simultaneous bilinguals and those children who are exposed to only Kannada from birth and learned English once they started schooling i.e. after three years of age were considered as sequential bilinguals.

To evaluate and match them on the language abilities in Kannada, semantic and syntactic sections of the Linguistic Profile Test in Kannada (LPT, Karanth, Ahuja, Nagaraja, Pandit, & Shivasankar, 1991) was administered. Sequential bilingual children had obtained a mean raw score of 147.70 and simultaneous bilingual children had obtained a mean raw score of 145.72. To evaluate and match them on the language abilities in English, English Language Test for Indian Children (Bhuvaneshwari & Jayashree, 2010) was administered. Sequential and simultaneous bilingual children had obtained mean overall raw scores of 132.25 and 148.84 respectively. They had age appropriate linguistic abilities in both languages. Further, to rule out articulatory errors 'Restandardization of Kannada articulation test' (Deepa & Savithri, 2010) was administered and none of them had any articulatory errors.

Ethical standards: Ethical procedures were followed to select the participants. The school principal and parents were explained the purpose and the procedure of the study and an informed verbal and written consent were taken.

Stimuli: A list of thirty nonwords in Kannada (ten each in 2syllable, 3syllable, and 4syllable length) from the 'Word and Nonword Repetition Test in Kannada' (NWRT-K, Swapna & Shylaja, 2012) (Appendix II) and thirty nonwords in English (Appendix III) was used as the stimulus. The thirty nonwords in English was constructed by selecting meaningful words of varying syllable lengths (2syllable, 3syllable, and 4syllable) from 'With a little bit of help-Early Language Training Manual' (Karanth, Manjula, Prema, & Geetha, 1999) and English text books following CBSE syllabus belonging to UKG, 1st and 2nd standard grades. This was done so as to ensure that these are within the vocabulary of the children. A total of 100 meaningful words were selected for two, three and four syllable length and different rules were applied to create 'nonwords'. The list of the nonwords was developed based on the following criteria.

1. The nonwords constructed were such that none of their individual syllables (CV or CVC) corresponded to English word. This was done to ensure that the nonwords included were not affected by a subject's vocabulary knowledge.
2. The nonwords contained sounds that were within the phonetic inventory of the children selected.
3. The nonwords did not include consonant clusters.
4. The consonants of the original word were maintained.
5. The nonwords developed followed the phonotactic rules of the English language.

The rules used to construct the nonwords were based on the rule followed in Early Repetition Battery (Seeff-Gabriel, Chiat, & Roy, 2008) which were as follows:

Rules used for preparation of 2-syllable length nonwords: The consonants of the original word were transposed. For example: today (word) to /dute/ (nonword).

Rules used for preparation of 3-syllable length nonwords: Three syllable nonword was formed by transposing two or three consonants of the two or three syllable nonword. For example: volcano (word) to kolnavo (nonword).

Rules used for preparation of 4-syllable nonwords: Three or four syllables nonwords were formed by transposition of two, three or four consonants of the four syllable word. For example, 4-syllable nonword: kintergarden(word) to dintergarken (nonword).

The prepared thirty nonword list in each of the syllable length was subjected to word likeness judgment on a 4- point rating scale by ten qualified speech-language pathologists with '3' denoting 100% word likeness and '0' denoting least degree of word likeness. After comparing the rating obtained for each nonword, a ranking was given for the nonwords in descending order starting from the nonword having maximum to least degree of word likeness. Ten nonwords which obtained maximum rating of '0' and '1' in each syllable length were included in the final list of nonwords. Equal number of stimuli from each syllable length was considered.

The final list of nonwords and five practice items were audio recorded by a twenty year old Kannada-English bilingual female speaker using Sony Walkman NWZ-B152F recorder. It had a sampling frequency of 22 KHz and 32 bit rate resolution. The recorded stimulus was then loaded into Cool Edit Pro software to maintain inter-stimulus interval of 4 seconds.

Procedure: A rapport was built with the child. The preliminary assessments and screening procedures were carried out. A silent environment with minimum distractions was selected. The list of nonwords which differed in two, three and four syllable length was presented along with the practice items through Cool Edit software using headphones at comfortable hearing level to the individual participants, in a quiet listening environment. Each participant was given the recorded instructions in Kannada and English through the headphones as following: "You are going to hear some funny made up words. Your job is to say them back to me, exactly the way you hear them. Some of the words will be short, and others will be longer. Listen carefully, because the words will be said only once. Here comes the first word".

The list of practice items were presented first, followed by test items in their first language. After completion of testing in the first language using Kannada nonwords, the same procedure was used to test in the second language using English nonwords. Responses were audio recorded using Sony Walkman NWZ- B152F recorder and saved into the PC separately as sequential and simultaneous groups. A total of eight minutes was taken for the completion of nonword repetition task in Kannada and English. However the total time spent with each child was approximately 45minutes. After the completion each participant was rewarded with a "smiley badge" for their cooperation. The nonwords were analyzed for overall accuracy, accuracy at different syllable lengths and type of errors. Test-retest reliability was established for 50% of the subjects selected for the study from each group. They were tested within a span of one to two weeks.

Analysis: The audio recorded samples obtained in the first and second language were transcribed using broad phonetic transcriptions and recorded in separate score sheets (Appendix II & III) by the experimenter. After transcription these were analyzed for the accuracy of the repetition and the type of errors with respect to two, three and four syllables. A sample score sheet used for the Kannada and English nonword repetition task for a participant has been provided in the appendix IV & V respectively. The accuracy of each of the individuals' responses was calculated.

Accuracy of the response: This comprises of the total number of items correctly repeated. The exact repetition of all the syllables in a nonword, as matched to the target nonword was considered as correct and assigned a score of '1'. Any syllable substitutions, omissions, and additions were considered as incorrect and scored '0'. The total number of nonwords correct out of the total nonwords was calculated for both the groups and languages and tabulated in the score sheet.

The accuracy was also calculated based on the length of the stimuli, i.e., the total number and percentage of two-syllable, three-syllable, and four-syllable items repeated correct for both the groups and for both the languages. The total number and percentage of vowels and consonants repeated correctly was also computed, where in the percentage of vowels/consonants correct was obtained by dividing the number of vowels/consonants correct by the total number of vowels/consonants multiplied by 100. This was calculated at each syllable length.

Error analysis: The total number and percentage of different types of errors such as substitutions, omissions, and additions were also computed for all the participants for the entire set of nonwords at each syllable length for both the languages.

Statistical analysis: The obtained data from both the groups for both the languages was appropriately tabulated and subjected to statistical measures. SPSS software (version 17) packages were used for statistical analysis. Descriptive statistics was used to compute the mean and standard deviation. Other statistical procedures such as Mixed ANOVA, repeated measures ANOVA, MANOVA, Boneferroni's pairwise comparison test, independent samples t-test, Mann Whitney test and Wilcoxon's signed rank were carried out to answer the research questions of the present study. The results are presented and discussed in detail in the next chapter.

CHAPTER IV

RESULTS AND DISCUSSION

The present study investigated the performance of forty four Kannada-English bilinguals on a nonword repetition task in their first and second language. These children were divided into two groups comprising of twenty two simultaneous bilinguals and twenty two sequential bilinguals. The stimuli were presented through headphones using a laptop computer and the responses of the children were audio recorded. This was further transcribed, scored and subjected to statistical analysis using SPSS version 17. The following statistical procedures were carried out:

- Cronbach's alpha coefficient to determine test-retest reliability.
- Descriptive statistical analysis to compute the mean and standard deviation for both the groups.
- Mixed ANOVA to examine the main effect and interaction effect among several variables.
- Independent sample t test to check for significant differences if any between groups.
- Repeated measures ANOVA to examine whether significant difference existed within groups across different syllable length.
- Bonferroni's pairwise comparison test to study if there was a significant difference in the performance of children within groups across pairs of different syllable lengths.
- MANOVA to find out the significant difference, if any in the performance between the groups on the aspects such as percent of vowel/consonants/syllables correct and percent of syllable substitutions/omissions/additions.

- Paired t-test to find out the significant differences, if any between percentage of vowels and consonants correct within groups.
- Wilcoxon signed ranks test and Mann-Whitney test for pairwise comparison across languages and groups.

The results of statistical analysis for both groups on both the tasks have been presented and discussed under different sections:

1. Test-retest reliability was computed for the overall accuracy of NWR tasks in Kannada and English
2. Comparison of overall accuracy on the NWR task across gender, groups and languages
3. Comparison of overall accuracy on the NWR task with respect to syllable length across groups and languages.
4. Comparison of percentage vowels correct (PVC) across different groups and languages
5. Comparison of percentage of consonants correct (PCC) across different groups and languages
6. Comparison of percentage of substitution/ omissions/ addition across different groups and languages.
7. Comparison of scores on the language test across simultaneous and sequential groups.

1. Test-retest reliability was computed for accuracy of NWR task in Kannada and English

To test the stability of nonword repetition performance across languages, 50% of participants in each group were retested using the NWR task in Kannada and English within two weeks. The test-retest reliability was calculated using Cronbach's coefficient alpha in each language. The test retest reliability was found to be 0.80 for NWR task in Kannada and 0.79 for NWR task in English. This suggested acceptable levels of test-retest reliability for the overall test.

2. Comparison of overall accuracy on the NWR task across groups, languages and gender

The mean and the standard deviation (SD) were computed using descriptive statistical analysis for both the groups, languages and gender. These values have been depicted in the Table 1. The mean values indicated that the overall accuracy of the repetition was better for the simultaneous bilingual group compared to the sequential bilingual group. This was on the whole seen in both the genders too. The simultaneous and the sequential group performed better on the Kannada NWR task.

Table 1

Mean and standard deviation (SD) for the nonword repetition task for two groups (both males and females) in both languages.

Language	Group	Gender				Gender total	
		Male		Female			
		Mean	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Kannada	Seq bil	73.94	8.14	76.06	5.123	75.00	6. 72
Language score	Simul bil	75.15	10.26	74. 85	8.35	75.00	9.12
English	Seq bil	56.96	11.8	54.24	11.55	55.60	11.51
Language score	Simul. bil	71.51	7.21	67.87	4.78	69.69	6. 25

[Seq bil= sequential bilinguals; simul bil= simultaneous bilinguals]

Table 2 shows the main effect and interaction effect for the variables such as language, group and gender which was computed using the mixed ANOVA. The results indicated that there was a significant main effect of language and group and there was a significant interaction effect of language on group and language on gender. However there was no significant main effect of gender and no significant interaction effect of language on gender alone, language on group and gender and group on gender.

Table 2

Main effect and interaction effect among the different variables.

Variables	df, E	F value	p value
Lang	1,40	51.91	0.00*
Lang * gp	1,40	16.89	0.00*
Lang * Gen	1,40	1.42	0.24
Lang * gp * Gen	1,40	0.05	0.83
Gp	1,40	12.19	0.00*
Gen	1,40	0.32	0.58
Gp * Gen	1,40	0.17	0.68

lang= language ; gp= group; Gen= gender; df= degree of freedom; E= error; sig= significance; *= p<0.05]

a. Comparison of overall scores on the Kannada and English NWR task across groups

The overall scores obtained on the NWR test were compared across the simultaneous and sequential groups for both the languages. The mean and standard deviation were computed using descriptive statistics. The mean percentage scores and standard deviation (SD) obtained for the NWR task in Kannada and English across groups have been depicted in Table 3. The mean percentage scores were similar for the simultaneous and sequential bilingual groups on the Kannada NWR task, whereas the mean percentage scores were higher for the simultaneous bilingual group compared to the sequential bilingual on the English NWR task. When the mean values for both Kannada and English NWR test was taken together, it can be seen that the simultaneous bilingual group performed better compared to the sequential bilingual group. MANOVA was used to check for significant differences, if any, between the simultaneous and sequential bilingual group. The results revealed a significant difference between the groups in English NWR at [$F (1, 42) = 25.42$, $p<0.05$].

Table 3

Mean and standard deviation (SD) values obtained on the Kannada and English NWR task in both the groups.

	Kannada NWR task		**English NWR task**	
	Mean	**SD**	**Mean**	**SD**
Simul. bil	75.00	9.13	69.69	6.25
Seq. bil	75.00	6.72	55.60	11.52

[Simul. bil= Simultaneous bilingual; Seq. bil= sequential bilingual]

Figure 1 shows the graphical representation of the mean values of sequential and simultaneous group on the Kannada and English nonword repetition test.

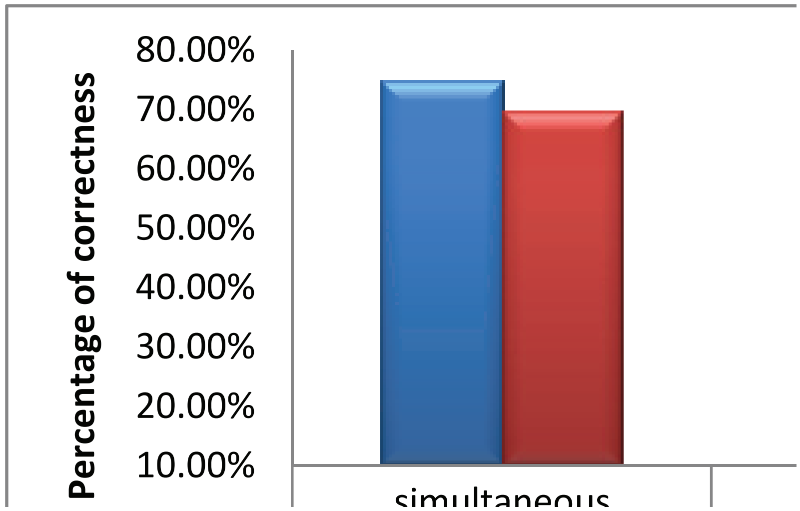

Figure 1: Comparison of the simultaneous and sequential bilingual groups on the Kannada and English NWR task.

b. Comparison of overall scores on NWR task across languages within each group.

In simultaneous bilinguals, the overall scores are higher for the Kannada NWR task (mean percentage =75) compared to the English NWR task (mean percentage = 69.69). Sequential bilinguals also a showed a superior performance on Kannada NWR (mean percentage = 75) compared to the NWR task in English (mean percentage = 55. 60). Independent t-test revealed a significant difference between Kannada and English NWR for both simultaneous bilingual children at [$t = (7.48)$, $p < 0.05$] and sequential bilinguals at [$t = (2.40)$, $p < 0.05$]. Figure 2 shows the graphical representation of the mean values of simultaneous bilinguals and sequential bilinguals with respect to overall scores obtained for Kannada and English NWR test in language.

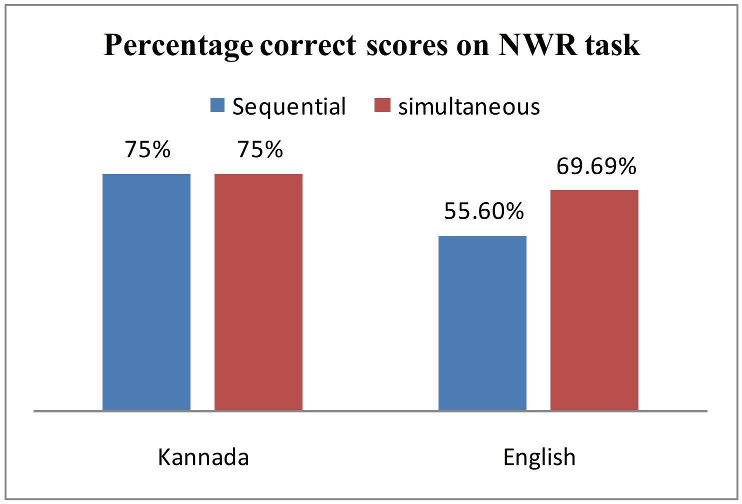

Figure 2: Comparison of overall scores for accuracy in each group across languages.

c. Comparison of overall scores across gender

The mean and standard deviation (SD) values obtained for both the gender in both groups on both NWR tasks have been depicted in Table 1. The mean correct scores obtained on the NWR task for simultaneous bilinguals and sequential bilinguals were compared across gender. The mean score obtained showed similar pattern in males and females for the NWR in their first and second language. A comparison of male and female mean scores revealed a similar performance on the NWR task in both languages.

In the Kannada NWR task, male sequential bilinguals obtained a mean percentage of 73.94 and female sequential bilingual children obtained a score of 76.06 which shows slightly higher ability of PWM for female sequential bilingual children compared to males. The mean percentage of 75.15 was obtained for male simultaneous bilingual children and 74.85 for female sequential bilingual children which shows similar performance across gender. Nonword repetition skills in the native language of simultaneous and sequential bilingual children were similar across gender.

In English NWR task, among the sequential children, the males obtained a mean percentage score of 56.96 and females obtained a mean percentage of 55.6 which showed similar performance across gender. The male simultaneous bilingual children obtained a mean percentage of 71.51 and females obtained a score of 67.88 which indicate a slightly higher phonological working memory capacity in males compared to females. Overall the comparison of nonword repetition scores for English and Kannada across groups and gender show a superior performance on nonword repetition skill in Kannada compared to nonword repetition in English.

Within simultaneous bilinguals, it was seen that the males had a slight advantage over the females during Kannada and English NWR task. However the same pattern was not observed in sequential bilingual children wherein the males performed slightly better compared to females on the English NWR task and the females performed better on the Kannada NWR task.

Mixed ANOVA was used to compare the gender statistically and results revealed no significant main effect of gender at [$F(1, 40) = 0.32$, $p>0.05$]. The performance of males and females has been depicted graphically in the Figure 3.

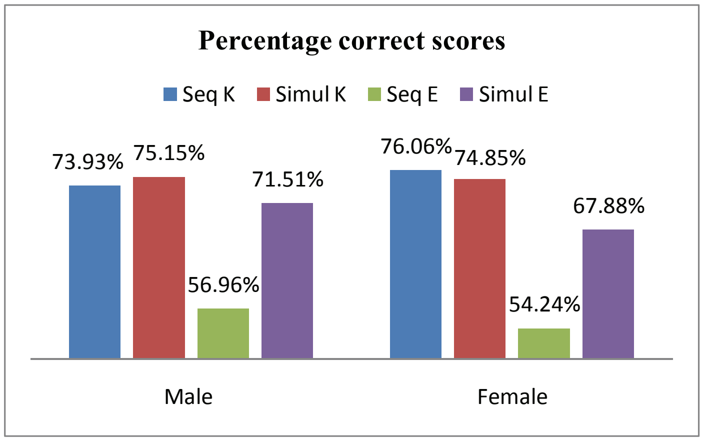

Figure 3: Mean correct scores on NWR task obtained for simultaneous and sequential bilinguals in males and females.

[Seq K= Sequential Kannada; Simul K= Simultaneous Kannada; Seq E= Sequential English; Simul E= Simultaneous English]

A comparison of mean scores obtained for the nonword repetition task by both the groups revealed better performance of simultaneous bilinguals in the English NWR task and a similar performance by both the groups on the Kannada NWR task. The result indicated that the simultaneous bilingual children exhibited better phonological working memory capacity for both Kannada and English whereas the sequential bilinguals showed poor a phonological working memory capacity in their second language which is English compared to their first language which is Kannada. This result indicates a language specific performance by the sequential bilingual children. This result was consistent with the results of Thorn and Gathercole (1999) where they highlighted the influence of language familiarity on short term memory performance in first and second language. Superior performance of the simultaneous bilingual group could be attributed to the greater amount of exposure to the second language, use of that language and thereby greater vocabulary and grammatical knowledge in that language. This view is in consonance with the findings and suggestions by Thorn and Gathercole (1999) where they suggested an advantage of language familiarity on the performance of NWR task. The results is also consistent with the results of study carried out by Sangeetha and Swapna (2011) where they found superior performance of simultaneous bilinguals in all cognitive-linguistic tasks using Cognitive Linguistic Assessment Protocol for children (CLAP- C). The results of the present study showed differences in NWR in English and Kannada by both the groups and this might be due to the differential linguistic experience. This result is consistent with the view of Lee and Gorman (2012) who highlighted the importance of linguistic experience on a nonword repetition task in a sequential bilingual child. The present results also support the view of Gutierrez-Clellen and Simon-Cereijido (2010) who suggested that the clinical accuracy of nonword repetition tasks varies depending on the languages tested and the performance might be related to the individual differences in language use and exposure. Results of Summers, Bohman, Gillam, Penta, and Bedore (2010) also found effect of morphosyntactic abilities on the performance of NWR task by sequential bilinguals.

The overall comparison of the scores obtained on the nonword repetition task for both simultaneous and sequential bilinguals across each language showed a superior performance on nonword repetition skill in Kannada compared to nonword repetition in English by both the groups. This finding can be attributed to the proficiency of both sequential and simultaneous bilingual in their first language i.e., the native language and the amount of exposure to that language. The children resided in Karnataka where the majority of the people spoke Kannada. The mean scores obtained for the test of language skills in Kannada and English for both the groups and the accuracy of responses obtained for both the groups were in a similar pattern. This indicates the influence of language structure on NWR tasks. This is in consistent with the finding of the Western studies done by Gutierrez-Clellen and Simon-Cereijido (2010), Summers, Bohman, Gillam, Penta, and Bedore (2010), Kaushanskaya and Yoo (2012) and Lee, Kim and Yim (2013) and an Indian study study by Shylaja, Abraham, Thomas, and Swapna (2011) where they found that better language abilities are related to better performance on NWR tasks. Hoff and McKay (2005) found a marginal relationship between vocabulary sizes and nonword repetition skills and results of Parra, Hoff, and Core (2011) also showed language-specific benefits on phonological memory in sequential bilinguals. The present results also support the finding of Miettinen (2012) who suggested that the connection between English (L2) knowledge and phonological working memory as assessed with an English nonword repetition test was fairly strong. Lee, Kim, and Yim (2013) also found a positive relation between nonword repetition and vocabulary skills.

3. Comparison of overall accuracy on NWR tasks based on syllable length across groups and languages

The mean percentage of accuracy on the NWR task based on syllable length and standard deviation was calculated using descriptive statistics which have been depicted in the Table 4. A comparison of mean scores at each syllable length on Kannada NWR tasks revealed that both the groups had the highest accuracy of repetition for the nonwords with three syllable length and lowest accuracy for nonwords at four syllable length. Similarly a comparison of mean scores at each syllable length on English NWR task revealed that both the groups had the highest accuracy of repetition for the two syllable length words and lowest accuracy for the four syllable length words. The mean value indicated similar pattern of performance in both the groups.

Table 4

Mean percentage of accuracy for nonwords across groups and languages.

Syllable length	**Sequential bilingual**		**Simultaneous bilingual**	
	Mean	**SD**	**Mean**	**SD**
K 2s	79. 69	12.55	82.27	16.31
K 3s	90.61	10.31	87.72	10.66
K4s	55.61	12.57	57.27	15.17
E 2s	79.55	14.63	84.09	9.08
E 3s	51.82	18.68	68.64	16.12
E 4s	35.91	14. 69	56.82	12. 49

[K 2s= Kannada two syllables, K 3s= Kannada three syllable, K 4s= Kannada four syllable
E 2s= English two syllable, E 3s=English three syllable, E 4s= English four syllable
Std. dev= standard deviation]

Mixed ANOVA was computed to compare the accuracy of response in the NWR task between the two bilingual groups and two languages across each syllable length, the results of which have been depicted in Table 5. The results revealed a significant main effect of language, length and group and there was a significant interaction effect of language on group, language on length and language on length, group and gender. There was no significant difference on the other variables as shown in Table 5. The results indicated that variations in language and length of the syllable did have an effect on the NWR performance of both simultaneous and sequential bilingual children. Further, Boneferroni's pairwise comparison test was carried out to compare accuracy of response across syllable lengths for the groups and the language as a whole. There was a significant difference at all syllable lengths at p<0.05.

Table 5

Main effect and interaction effect among the different variables.

Variable	Df, E	F value	p value
Lang	1,40	50.85*	0.00*
Lang * gp	1,40	14.59*	0.00*
Lang * Gen	1,40	1.41	0.24
Lang * gp * Gen	1,40	0.01	0.93
Length	2,80	149.30*	0.00*
Length * gp	2,80	2.26	0.11
Length * Gen	2,80	2.67	0.08
Length * gp * Gen	2,80	2.96	0.06
Lang * length	2,80	28.99	0.00*
Lang * length * gp	2,80	3.26*	0.00*
Lang * length * Gen	2,80	1.08	0.35
Lang * length * gp * Gen	2,80	3.45*	0.04*
Gp	1,40	12.64*	0.00*
Gen	1,40	0.26	0.61
Gp* Gen	1,40	0.02	0.88

[lang= languages; gp= group; Gen= gender;*= p<0.05]

a. Comparison of overall scores based on syllable length across groups for each language

When the mean values obtained for the two bilingual groups were compared across syllable length, it was seen that the simultaneous bilingual group had higher mean score at all syllable lengths for both languages except at Kannada three syllable length nonwords. This indicated a superior performance of simultaneous bilingual children. Even for the Kannada three syllable length nonwords the difference between the mean score was very minimal indicating not much of a difference between the two groups.

MANOVA was computed to check for significant difference, if any, across groups for each language at different syllable lengths. The results indicated that there was a significant group difference on the accuracy of response at three syllable length at [$F(1,42) = 10.22$, $p< 0.05$] and four syllable length at [$F(1,42) = 25.87$, $p< 0.05$] for the English NWR task. In Kannada NWR task, there was no significant difference between groups at each syllable length. Figure 5 shows the comparison of overall accuracy of NWR across group for each language.

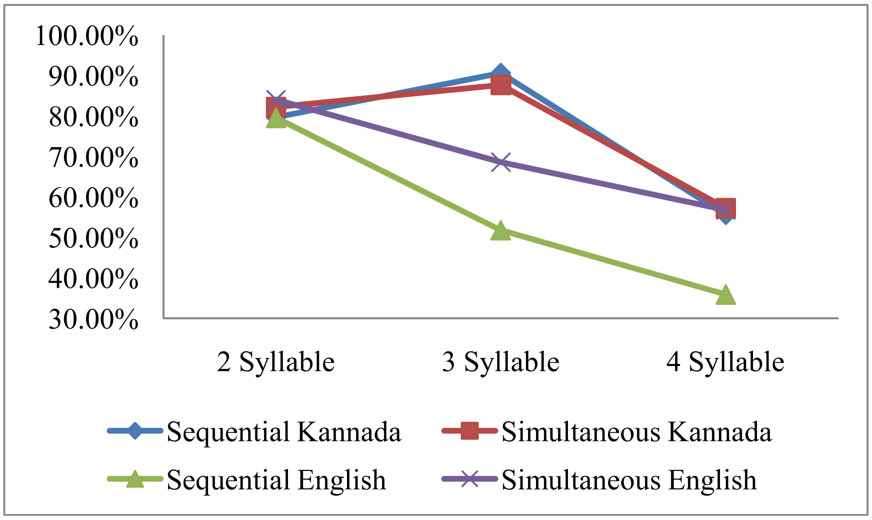

Figure 4: Mean percentage of correctness across group, language and gender.

[K 2s= Kannada two syllable, K 3s= Kannada three syllable, K 4s= Kannada four syllable, E 2s=English two syllable, E 3s= English three syllable, E 4s= English four syllable]

b. Comparison of overall scores based on syllable length across languages in each group.

The sequential bilingual group had greater difficulty with the English three and four syllable length nonwords compared to the Kannada three and four syllable length nonwords. The two syllable length nonwords in both languages were of equal difficulty for them. The same pattern was observed in the simultaneous bilingual group too. However the Kannada two syllable length nonwords were more difficult for them compared to the English two syllable length nonwords.

Independent t- test was done to compare the performance of each group across languages which have been depicted in the Table 6. The results revealed a significant difference between Kannada three syllable length nonwords and English three syllable length nonwords at [$t(1, 21)=9.09, p<0.05$] in sequential bilingual children and there was also a significant difference between four syllable length nonwords in Kannada and English at [t(1,21)=4.82,p< 0.05]. Independent t- test was carried out for simultaneous bilingual children revealed a significant difference between Kannada three syllable nonwords and English three syllable nonword repetition at [t(2,21)=6.35,p<0.05].

Table 6

Comparison of overall scores based on syllable length across languages in each group.

Pair	Sequential bilingual			Simultaneous bilinguals		
	t value	**df**	**p value**	**t value**	**df**	**p value**
K 2s- E 2s	0.03	21	0.98	4.70	21	0.64
K 3s- E 3s	9.09	21	0.00	6.34	21	0.00
K 4s- E 4s	4.82	21	0.00	0.09	21	0.92

[K 2s= Kannada two syllable; E2s= English two syllable; K3s= Kannada three syllable; E 3s= English three syllable; K4s= Kannada four syllable; E 4s= English four syllable].

c. Comparison of overall scores across syllable length within each language in each group

In general the mean values revealed that as the syllable length increased the overall scores decreased. This is especially true with regard to the English NWR task. In the Kannada NWR task, however it was seen that the mean values did not follow the same pattern across the syllable length. Although the scores were least for the four syllable length nonwords, the scores were highest for the three syllable length nonwords. The mean values of the two syllable length nonwords were lesser than that for the three syllable length nonwords.

Repeated measure ANOVA was computed for each group within languages across syllable lengths, the results of which have been depicted in the Table 7. The results indicated a significant effect of different syllable lengths on the accuracy of response in each group within different languages. Further, Boneferroni's pairwise comparison test was carried out to find out the accuracy of response in different syllable lengths across groups and within each language.

Table 7

Results of repeated measures ANOVA across syllable length in each language and group.

NWR scores across syllable length	Sequential bilingual			Simultaneous bilingual		
	df, E	**F value**	**p value**	**df, E**	**F values**	**P value**
Kannada	2,42	50.00	0.00	2,42	35.84	0.00
English	2,42	55.79	0.00	2,42	21.69	0.00

[E= error; df= degree of freedom]

In the Kannada NWR task, the accuracy of response obtained for the simultaneous bilingual group at two syllable length nonwords differed significantly from four syllable length nonwords. Accuracy of response at three syllable length nonwords differed significantly from four syllable length nonwords and accuracy of response at four syllable length nonwords differed significantly from two and three syllable length nonwords in the simultaneous bilingual group. This result indicated a significant difference at longer nonword syllable length compared to shorter nonwords on simultaneous bilinguals in Kannada. The accuracy of response for Kannada NWR at two, three and four syllable length nonwords differed from each other significantly in the sequential bilingual group.

In the English NWR task, the accuracy of response obtained at two syllable length nonwords differed significantly from three and four syllable length nonwords in both the simultaneous and sequential bilingual groups. Accuracy of response at three syllable length nonwords differed significantly from two syllable length in both the groups and accuracy of response at three syllable length nonwords differed significantly from four syllable lengths nonwords in sequential bilingual group but not in the simultaneous bilingual group. Finally, the accuracy of response at four syllable length nonwords differed significantly from two syllable length nonwords in both the simultaneous and sequential bilingual groups, however the accuracy at the four syllable length nonwords differed significantly from the three syllable lengths only in the sequential bilingual group.

The overall results showed a significant difference between the simultaneous and sequential bilingual children. In sequential bilinguals, the correct scores obtained for the nonword repetition in Kannada differed significantly from English at three and four syllable length and the simultaneous bilinguals showed only significant differences at three syllable length nonwords across languages. There was a higher percentage of accuracy obtained for Kannada NWR task for both groups compared to English NWR task. Each language maintained a similar pattern of difficulty across groups. On comparing the pattern of accuracy of English NWR across groups, it was seen that the difficulty level increased as the syllable length increased.

This finding was in consensus with the findings of Gathercole (2006), Summers, Bohman, Gillam, Penta, and Bedore (2010) and Kaushanskaya and Yoo (2012) where they found a decrease in nonword repetition accuracy at different syllable length in both languages. The result is also consistent with the Indian study done by Shylaja, Abraham, Thomas, and Swapna (2011) where they found decreased percentage of accuracy at longer nonwords. In the present study it was found that there was a better accuracy at three syllable lengths compared to two syllable lengths in both bilingual groups in Kannada. This finding could be attributed to the concept of perceptual salience effect suggested by Bates and MacWhinney (1987) in which the two syllable length was too short to be perceived accurately. Majerus et al. (2006) and Alt (2010) also reported that the short nonwords showed difficulty in initial phonological perception or encoding of phonological forms. Lee, Kim and Yim (2013) also found better accuracy of performance on nonword repetition with three syllable length compared to the two syllable lengths in bilingual children in their native language. This result was strongly consistent with the result of an Indian study done by Shylaja and Swapna (2011) on NWR task in Kannada where they found no significant difference between two syllable length and three syllable length nonwords.

4. **Comparison of Percentage of Vowel correct (PVC) based on syllable lengths groups and languages**

The mean and standard deviation (SD) values for the PVC at each syllable length on the NWR tasks were computed using descriptive statistics and the same has been shown in the Table 8. When PVC at each syllable length was considered, the simultaneous bilinguals had higher PVC at all syllable lengths in both the languages except at the Kannada four syllable length nonwords where the sequential bilinguals had higher PVC. However these differences are minimal, the mean values indicated similarities in performances across groups. Simultaneous and sequential bilinguals showed a higher performance on PVC in Kannada when compared to the NWR task in English. Figure 6 shows the comparison of PVC across groups, languages and lengths.

Table 8

Mean and standard deviation (SD) for PVC at each syllable length across groups and languages.

Syllable length	**Sequential bilingual**		**Simultaneous bilingual**	
	Mean	**SD**	**Mean**	**SD**
K 2s	96.51	5.39	98.18	4.51
K 3s	99.08	2.11	99.39	1.67
K4s	97.05	2.84	96.36	3.51
E 2s	94. 09	3.98	95.00	3.45
E 3s	90. 29	6.07	93.18	5.58
E 4s	87. 04	4.79	89.77	5.28

[K= Kannada; E= English; 2s= syllable; 3s= 3 syllable; 4s= 4 syllable]

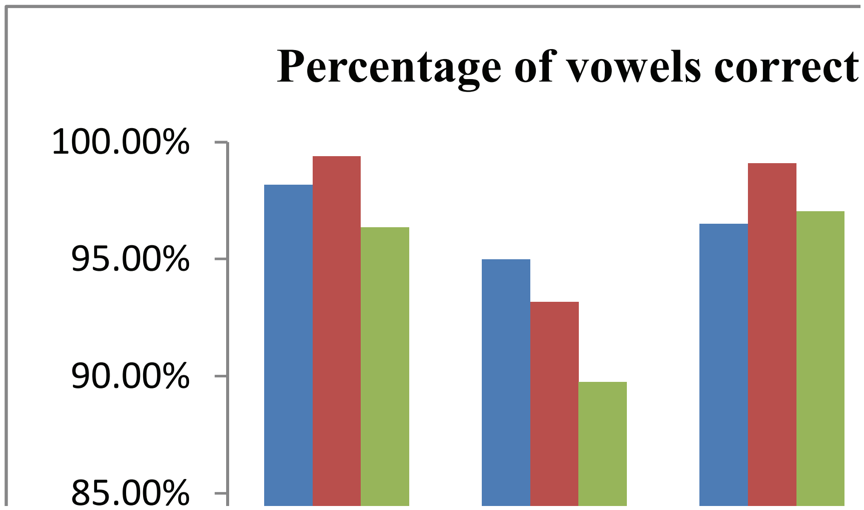

Figure 5: Mean PVC across group, language and different syllable length.

[Sim.Kan=Kannada simultaneous; Sim. Eng= English simultaneous; Seq. Kan= Kannada sequential; Seq. Eng= English sequential; 2s= two syllable; 3s= three syllable; 4s= four syllable]

PVC was highest for the three syllable length in both the groups in Kannada language, whereas PVC was the lowest for the two syllable length in the sequential bilingual group and lowest for four syllable length in the simultaneous bilingual group. In English highest PVC was at the two syllable length and lowest PVC was at the four syllable length in both the groups.

Mixed ANOVA was used to examine the variation of PVC with respect to language, vowel based on syllable length, gender and group. The results indicated a significant main effect of language, main effect of syllable length (vowel) and interaction effect of language with syllable length (vowel) and also an interaction of language with group, gender and syllable length. The result of mixed ANOVA revealed that the remaining variable did not show significant main or interaction effect as given in the Table 9.

Table 9

Main effect and interaction effect among variables.

Variable	df, E	F value	p value
Lang	1,40	116.52	0.00*
Lang * gp	1,40	2.30	0.14
Lang * Gen	1,40	1.41	0.24
Lang * gp * Gen	1,40	0.05	0.83
Vowel	2,80	21.18	0.00*
Vowel * gp	2,80	0.13	0.89
Vowel * Gen	2,80	3.07	0.05
Vowel * gp * Gen	2,80	2.03	0.14
Lang * vowel	2,80	16.96	0.00*
Lang * vowel * gp	2,80	2.34	0.10
Lang * vowel * Gen	2,80	2.73	0.07
Lang * vowel * gp * Gen	2,80	7.34	0.00*
Gp	1,40	3.27	0.08
Gender	1,40	0.01	0.94
Gp * Gen	1,40	0.49	0.49

[lang= languages; Gp= group; Gen= gender;*= p<0.05]

Further, Boneferroni's pairwise comparison test was done to compare different syllable lengths when languages and groups were considered as a whole. The results indicated that the PVC at two syllable nonwords was significantly different from that of four syllable lengths nonwords and vice versa. PVC at four syllable nonwords was significantly different from two and three syllable nonwords. PVC at two syllable nonwords was not significantly different from three syllable nonwords and vice versa. This indicated that the accuracy of responses at four syllable length was significantly different from two and three syllable length.

a. Comparison of PVC across groups

Mixed ANOVA revealed no significant main effect of group at [$F(1, 40) = 3.27$, $p>0.05$]. Statistical procedure MANOVA was computed to find out the group differences in each language based on syllable length and the results indicated no significant difference between the simultaneous and sequential bilingual group.

b. Comparison of total PVC in each language across syllable length

As discussed earlier, there was a significant difference across syllable lengths when languages considered as a whole at $p<0.05$. Further statistical analysis was done to find out the PVC across syllable length in each language.

i. PVC within Kannada

Repeated measures ANOVA was carried out to evaluate whether significant difference existed in the PVC in nonwords at different syllable length in Kannada NWR task. The results showed a significant difference on PVC at different syllable lengths in Kannada nonwords at [$F(2, 86) = 7.428, p<0.05$]. Further a Boneferroni's pair wise comparison test was used to find which syllable lengths differed significantly from each other in NWR task. The results indicated that PVC at two syllable length nonwords was significantly different from PVC at three syllable length nonwords. PVC at three syllable length nonwords was significantly from PVC at two and four syllable length nonwords and PVC at four syllable length nonwords was significantly from PVC at three syllable length nonwords. Overall comparison revealed that the PVC at two syllable nonwords were similar to that of four syllable nonwords and it differed significantly from that of three syllable length nonwords.

ii. PVC within English

Repeated measures ANOVA was done to evaluate whether significant difference existed in the PVC in nonwords at different syllable lengths in the English NWR task. The results showed a significant difference on PVC at different syllable length in English nonwords at [$F(2,86) = 22.453$, $p<0.05$]. Further a Boneferroni's pair wise comparison test was carried out to find which syllable lengths differed significantly from each other in the NWR task. The results indicated that PVC at two syllable length nonwords was significantly different from PVC at three and four syllable length nonwords. PVC at three syllable lengths was significantly different from PVC at two and three syllable length. PVC at four syllable length was significantly from PVC at two and three syllables. Overall the results revealed that PVC at two, three and four syllable differed significantly in English NWR task.

iii. PVC across languages based on syllable length

Paired t - test was used to compare the PVC between Kannada and English at two, three and four syllable length as shown in the Table 10. Results showed a significant difference between Kannada and English on PVC at different syllable lengths which showed the influence of language specific knowledge.

Table 10

Pairwise comparison of PVC between Kannada and English NWR task.

Pair	t value	(Sig. 2 tailed)
K 2s- E 2s	3.17	0.00*
K 3s- E 3s	8.33	0.00*
K 4s- E 4s	10. 07	0.00*

[K= Kannada; E= English; 2s= syllable; 3s= 3 syllable; 4s= 4 syllable; *p<0.05]

Comparison of total mean obtained for simultaneous and sequential bilinguals revealed a superior performance of simultaneous bilinguals compared to sequential bilinguals. Overall the results showed that the total PVC was higher for simultaneous bilingual group compared to sequential bilingual group and higher mean value for Kannada language compared to English language. It was found that in simultaneous and sequential bilinguals mean PVC scores decreased with increase in syllable length for nonword repetition in English i.e., there was a decrease in PVC from two syllable nonwords to four syllable nonwords in English.

Comparison across syllable lengths revealed a similar score on PVC at two and three syllable lengths and this result was consistent with results of the study carried out by Swapna and Shylaja (2011) where they found a similar performance on PVC across two syllable length and three syllable length in Kannada language. There was a significant difference in performance on PVC at two and four syllable lengths and at three and four syllable lengths. The significant difference on the PVC between three and four syllable length is consistent with result of Swapna and Shylaja (2011). Comparison of PVC scores in each language based on syllable length revealed significant difference between all syllable lengths on PVC in English.

The result of the present study showed a simultaneous bilingual advantage which is contradicting to the results of the study done by Shylaja, Abraham, Thomas, and Swapna (2011) where they obtained a superior performance of sequential bilingual compared to simultaneous bilinguals. This might be due to the differences in the sample size considered in both studies. The present study was the first in the Indian literature that conducted a detailed evaluation of accuracy with respect to vowels in both simultaneous and sequential bilingual population across two languages. Overall decrease in PVC as the syllable length increased is consistent with the study by Shylaja, Abraham, Thomas, and Swapna (2011) and Swapna and Shylaja (2011) where they found a decrease in PVC as the syllable length increased from two syllable length nonwords to five syllable length nonwords.

5. Comparison of percentage of consonants correct (PCC) across groups and languages

The mean and the standard deviation values for the Percentage of Consonants Correct (PCC) scores at each syllable length across groups and languages were computed and the same has depicted in Table 11. Highest PCC was obtained for sequential bilingual children in the Kannada NWR tasks followed by the English NWR by simultaneous bilinguals. When all the groups were compared across syllable lengths and language, maximum PCC was obtained for English nonword repetition by simultaneous bilingual children compared to sequential bilingual children. Based on PCC at different syllable lengths, highest PCC was obtained for Kannada NWR by both the groups at three syllable length and highest PCC was obtained for English NWR by both the groups at two syllable length. PCC obtained for Kannada nonwords and English nonwords by simultaneous and sequential bilinguals showed same pattern for two, three and four syllable length as shown in the Figure 6.

Table 11

Mean and standard deviation (SD) for PCC at each syllable length across groups in both languages.

Syllable length	**Sequential bilinguals**		**Simultaneous bilinguals**	
	Mean	**SD**	**Mean**	**SD**
K 2s	91.14	7.23	91.59	10.28
K 3s	97.58	2.94	96.06	4.32
K4s	86.25	4.54	86.36	5.16
E 2s	95.75	4.15	96.77	2.63
E 3s	88.37	6.69	92. 12	5.28
E 4s	90.91	5.48	94.36	2.82

[K = Kannada; E = English; 2s = syllable; 3s = 3 syllable; 4s = 4 syllable]

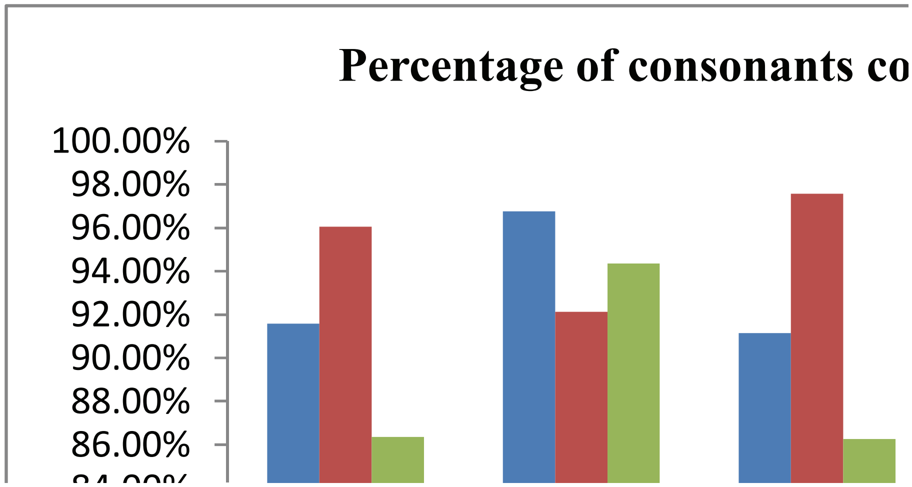

Figure 6: Mean PCC across group, language and different syllable length.

[Sim. Kan = Kannada simultaneous; Sim. Eng = English simultaneous; Seq. Kan = Kannada sequential; Seq. Eng = English sequential; 2s = two syllable; 3s = three syllable; 4s = four syllable]

Mixed ANOVA was used to examine the variation of PCC due to the effect of variables like gender, group, language, and syllable length as shown in Table 12. The results indicated that there was a significant main effect found on consonants based on syllable length and a significant interaction effect of languages with consonants at different syllable length. There was no significant main effect of language and no interaction effect of language with group and gender, consonants with group and gender and no interaction effect of language with consonant, group and gender. There was no significant difference between groups, between gender and no interaction effect between group and gender.

Further, PCC was compared across the different syllable lengths using Boneferroni's pairwise comparison test. PCC at two syllable nonwords was significantly different from that of four syllable length and vice versa. PCC at two syllable nonwords was not significantly different from three syllable nonwords and vice versa. PCC at four syllable nonwords was significantly different from two and three syllable nonwords. Overall results indicated similar scores on PVC at two and three syllable length.

Table 12

Main effect and interaction effect among variable for PCC.

Variable	(df, E)	F	Sig
Lang	1,40	3.79	0.07
Lang * gp	1,40	3.69	0.06
Lang * Gen	1,40	1.08	0.30
Lang * gp * Gen	1,40	0.00	0.98
Cons	2,80	18.67	0.00*
Cons * gp	2,80	0.22	0.80
Cons * Gen	2,80	1.59	0.21
Cons * gp * Gen	2,80	0.46	0.64
Lang * cons	2,80	46.08	0.00*
Lang * cons * gp	2,80	1.28	0.28
Lang * cons * Gen	2,80	0.34	0.72
Lang * cons * gp * Gen	2,80	1.58	0.21
Group	1,40	2.42	0.13
Gender	1,40	0.99	0.33
Gp * gen	1,40	0.12	0.73

[Lang = languages; Gp = group; Gen = gender; Cons = consonants; * = $p < 0.05$]

a. Total PCC based on syllable length across groups

There was no significant difference between sequential and simultaneous groups on total PCC at each syllable length at $p<0.05$.

b. Comparison of total PVC in each language across syllable length

i. PCC within Kannada

Repeated measures ANOVA was done to evaluate whether significant difference was present on PVC at different syllable lengths in Kannada. The results showed a significant difference on PVC at different syllable lengths in Kannada nonwords at [$F (2, 86) = 35.67$, $p < 0.05$]. Further a Boneferroni's pair wise comparison test was used to find which syllable lengths differed significantly from each other in NWR. The results indicated that PCC at two syllable lengths was significantly different from PCC at three and four syllable length. PCC at three syllable length was significantly from PCC at two and three syllable length. PCC at four syllable length was significantly different from PCC at two and three syllable. Overall there was a significant difference in the PCC between all syllable lengths at $p<0.05$.

ii. PCC within English

Repeated measures ANOVA was done to evaluate the main effect of length on PCC score of English. The results showed a significant difference on PCC at different syllable lengths in English nonwords a [$F (2, 86) = 23.38$, $p < 0.05$]. Further a Boneferroni's pair wise comparison test was used to find which syllable lengths differed significantly from each other in NWR task. The results indicated that PCC at two syllable lengths was significantly different from PCC at three and four syllable lengths. PCC at three syllable length was significantly from PCC at two and three syllable length. PCC at four syllable length was significantly from PCC at two and three syllable. The overall result showed that PCC at two, three and four syllable lengths differed significantly in English NWR task at $p<0.05$.

iii. PCC across languages based on syllable length

Paired t-test was used to compare the PCC between Kannada and English at two, three and four syllable length as shown in the Table 13. The results showed a significant difference between Kannada and English on PCC at different syllable lengths which shows the influence of language specific knowledge.

Table 13

Pairwise comparison of PCC between Kannada and English.

Pairs	t value	(Sig. 2 tailed)
K 2s- E 2s	3.167	.003*
K 3s- E 3s	8.329	.000*
K 4s- E 4s	10. 067	.000*

[K= Kannada; E= English; 2s= syllable; 3s= 3 syllable; 4s= 4 syllable; *p<0.05]

To sum, the results of the present study showed higher percentage of consonants correctness for simultaneous bilingual group compared to the sequential bilingual group. Highest percentage was obtained for English NWR task for simultaneous bilingual children and an equal PCC was obtained for the Kannada and the English NWR task by sequential bilingual children. The current result revealed more errors on consonants compared to vowels. This result was in consonance with the finding of Girbau and Schwartz (2007) and Shylaja, Abraham, Thomas, and Swapna (2011) who found more preserved PWM for vowels compared to consonants. However the current result was contradicting to the study done by Shylaja, Abraham, Thomas, and Swapna (2011) where they found highest PCC in sequential bilingual children for nonword repetition in Kananda compared to simultaneous bilinguals. This could be the result of maintaining the use of both languages in the society by the simultaneous children and also influence of lifestyle with modern technologies and resources available to them which helps in facilitating and maintaining the linguistic abilities in the second language English. Interestingly it was found that there was higher PCC at four syllable length compared to three syllable lengths in both the groups.

6. Comparison of percentage of substitution / omissions/ addition across different groups and languages.

a. Comparison of percentage of syllable substitution (PSS) across different groups and languages.

The repetition response was analyzed for errors such as substitutions, omissions, and additions and percentage of each of these were computed. The mean, median and standard deviation were calculated using case summaries and have been represented in the Table 14. The results show higher percentage of syllable substitution at four syllable nonwords in both the groups. In Kannada NWR, simultaneous and sequential bilingual groups showed higher percentage of syllable substitution at four syllable lengths followed by two syllable lengths and then three syllable lengths. In English NWR, both simultaneous and sequential bilinguals followed increasing order of percentage of syllable substitution as the syllable lengths increased from two syllables to four syllables. Higher percentage of substitution errors was found for English NWR at four syllable length.

Table 14

Mean, Median and standard deviation (SD) values for the errors at each syllable length.

	Sequential bilinguals			**Simultaneous bilinguals**			**Group**
	Mean	**Median**	**SD**	**Mean**	**Median**	**SD**	**/z/**
K 2SS	10.79	10.00	7.69	9.31	10.00	10.38	4.05
K 3SS	2.57	3.31	3.07	3.93	3.33	3.50	3.19
K 4SS	14.55	13.75	5.65	15.11	12.50	6.43	5.63
E 2SS	9.31	7.50	7.44	7.50	5.00	4.00	2.66
E 3SS	15.29	13.33	10.11	10.06	10.00	6.24	4.43
E 4SS	16.68	15.00	6.52	12.61	12.50	4.46	1.60

[K 2SS = Kannada two syllable substitution; K 3SS = Kannada three syllable; K 4SS = four syllable substitution; E 2SS = English two syllable substitution; E 3SS = English three syllable substitution; E 4SS = English four syllable substitution; Seq = sequential; Sim = Simultaneous; SD = standard deviation].

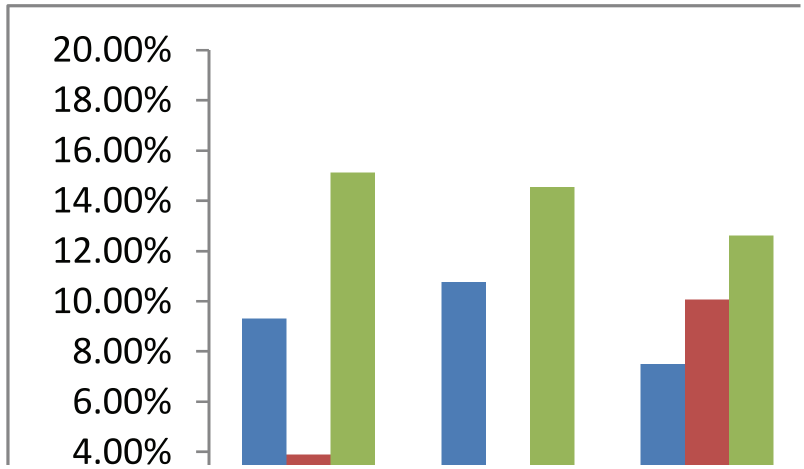

Figure 7: Percentage of syllable substitution across group, language and syllable length.

[Sim.Kan=Kannada simultaneous; Sim. Eng= English simultaneous; Seq. Kan= Kannada sequential; Seq. Eng= English sequential; 2s= two syllable; 3s= three syllable; 4s= four syllable].

b. **Comparison of percentage of syllable substitution across group and across gender**

Comparison of Kannada and English NWR across groups and gender was computed using Mann-Whitney Test as shown in the Table 15. The results revealed no significant effect of group and gender on percentage of syllable substitution at each syllable at p>0.05.

Table 15

Results of Mann-Whitney test for PSS at each syllable length across group and gender.

	Group		Gender	
	/z/ value	**p value**	**/z/ value**	**p value**
K 2SS	1.22	0.22	1.27	0.21
K 3SS	1.58	0.11	0.66	0.51
K 4SS	0.29	0.78	0.27	0.78
E 2SS	0.49	0.62	0.82	0.40
E 3SS	1.61	0.11	1.19	0.23
E 4SS	1.31	0.21	1.11	0.27

[K 2SS= Kannada two syllable substitution; K 3SS= Kannada three syllable; K 4SS= four syllable substitution; E 2SS= English two syllable substitution; E 3SS= English three syllable substitution; E 4SS = English four syllable substitution; Seq= sequential; Sim= Simultaneous]

Friedman test was computed to find out the effect of each language on percentage of syllable substitution and results revealed a significance effect of Kannada at $x^2=50.098$, $p<0.05$ and significant effect of English at $x^2=17.943$, $p<0.05$ on percentage of syllable substitution. Further Wilcoxon signed rank test was used to compare different syllable lengths in each language as shown in the Table 14 and also a pairwise comparison for each syllable length across language which has been depicted in the Table 16. Pairwise comparison for each syllable length revealed significant difference between different syllable lengths in Kannada and PSS at three syllable length and four syllable lengths differed significantly from two syllable length. Pairwise comparison between languages at each syllable length was computed using Wilcoxon signed rank test and results showed a significant difference in PSS between both languages at three syllable length.

Table 16

Pair wise comparison across languages at different syllable length.

Pairs	/z/ value	P value
K 2s- E 2s	1.07	0.23
K 3s- E 3s	5.07	0.00*
K 4s- E 4s	0.15	0.88

[K= Kannada; E= English; 2s= syllable; 3s= 3 syllable; 4s= 4 syllable; *p<0.05]

Highest percentage of syllable substitution was obtained for English in both groups and was obtained at four syllable length. Sequential bilinguals showed greater number of substitution errors compared to simultaneous bilingual group on NWR task in English. This could be attributed to the lesser amount of use of the second language, age of acquisition of the second language and less vocabulary knowledge in the second language compared to the first language. Comparing the substitution errors by both the groups on NWR in Kannada revealed similar percentage of errors. Less substitution errors were found on NWR in Kannada which could be the result of better linguistic skills in their native language. However syllable substitution was found to be the most common error in both languages and groups. This is in consonance with the study done by Girbau and Scwartz (2007) who found that consonant substitutions were most frequent error type in both typically developing and SLI.

It was also observed that the most commonly occurring syllable substitution errors were voicing errors (mainly found in stop consonants) and the substitution of target sound with a sound which has same place of articulation.

Percentage of syllable omission and percentage of syllable substitution were not evaluated for the significant difference between groups as the median was zero and the standard deviation value was very high.

7. Comparison of scores on the language test across simultaneous and sequential groups

The mean and standard deviation values were computed using descriptive statistics for the comparison of performance on the Kannada language and English language test for each group. These values have been depicted in Table 17.

Table 17

Mean and standard deviation (SD) for the scores obtained on English and Kannada language test across groups.

	Scores on English Language Test		**Scores on Kannada Language Test**	
	Mean	**SD**	**Mean**	**SD**
Simultaneous bilinguals	148.84	7.478	145.72	4.34
Sequential bilinguals	132.25	5.194	147.70	4.31

The combined mean scores obtained for the semantic and syntax section of Linguistic Profile Test in Kannada (LPT, Karanth, Ahuja, Nagaraja, Pandit, & Shivashankar, 1991) by simultaneous and sequential bilingual children were almost similar i.e., the mean of the simultaneous bilinguals was 145.72 and the mean score of the sequential bilingual was 147.70. The combined mean scores obtained for the semantic and syntax section of the English Language Test for Indian Children (ELTIC, Bhuvaneshwari & Jayashree, 2010) revealed higher scores for the simultaneous bilinguals (148.84) compared to the sequential bilinguals (132.25). Mean scores of the languages revealed that the simultaneous bilinguals had higher mean scores on the ELTIC compared to LPT in Kannada and the sequential bilinguals had higher mean scores on LPT compared to the ELTIC. The mean scores obtained on the Kannada and English language test for both sequential and simultaneous bilinguals have been depicted in Figure 8.

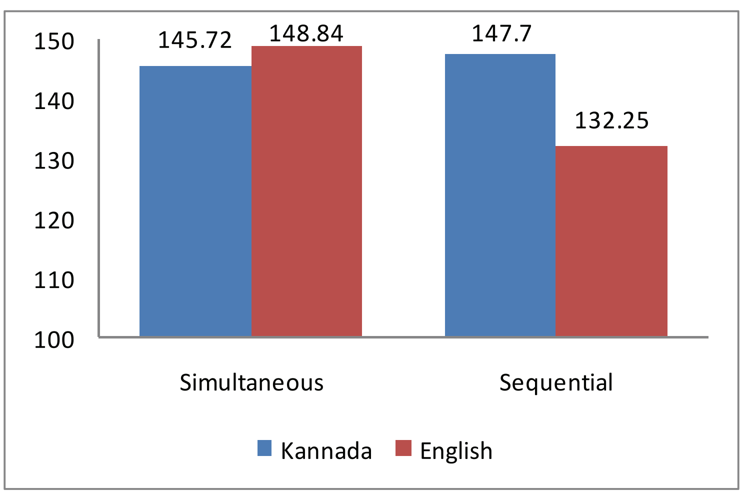

Figure 8: Mean of language score across language and group.

Pairwise comparison between the sequential and simultaneous bilinguals was statistically carried out using the Independent t- test. The results revealed that there was a significant difference between English language scores and Kannada language scores in the sequential bilinguals at [$t\ (1, 21) = 7.41, p<0.05$] and in simultaneous bilinguals at [$t\ (2, 21) = 2.239, p<0.05$].

The overall results indicated a superior and almost an equal performance of simultaneous bilinguals in both Kannada and English language abilities and the sequential bilinguals had comparatively a better command over the Kannada language. The sequential bilinguals had a slight advantage over the simultaneous bilinguals in Kannada language, whereas the simultaneous bilinguals showed a superior performance in the use of complex grammatical structures of English compared to the sequential bilinguals. These results are consistent with the explanation provided in a study carried out by Shylaja, Abraham, Thomas, and Swapna (2011) where they found fluent, proficient, greater and better more production of grammatically complex sentences in English by simultaneous bilingual children.

Almost equal abilities in Kannada and English language by the simultaneous bilingual children revealed a constant use of first and second language. In the Indian scenario, the social values are emphasized and consequently the child gets to interact with their neighbors, friends, relatives and grandparents, and in the process would have to use both the languages. Hence the simultaneous bilingual children get the opportunity to develop and maintain equal or almost equal linguistic abilities in their both languages.

On the other hand, the sequential bilinguals showed a superior performance in their native language Kannada compared to English. This is consistent with the results of the study done by Shylaja, Abraham, Thomas, and Swapna (2011) where the sequential bilinguals outperformed the simultaneous bilinguals in the Linguistic Profile Test. This could be attributed to their deep and more abundant vocabulary knowledge of Kannada language which developed during the first three years since they were exposed to only one language and therefore the language is well learned in terms of all the components.

In summary, the overall accuracy of scores revealed language specific performance by sequential and simultaneous bilingual group. When each group was considered simultaneous showed a superior performance over sequential bilingual children. Similar phonological working memory capacity was shown by both groups in their native language and simultaneous bilinguals outperformed the sequential bilingual children on NWR in their second language. There was a language specific performance by sequential bilinguals with superior performance on NWR in Kannada. Within simultaneous bilinguals, it was seen that the males had a slight advantage over the females during Kannada and English NWR task. However the same pattern was not observed in sequential bilingual children wherein the males performed slightly better compared to females on the English NWR task and the females performed better on the Kannada NWR task. Results were obtained for accuracy of response with respect to syllable length and it showed language specificity i.e., both groups maintained similar pattern of performance in each language across syllable length. In English NWR task, difficulty increased as the syllable length increased. There was a simultaneous bilingual advantage over sequential bilinguals on percentage of vowels correct score and percentage of consonant correct scores. Substitution errors were more compared to omissions and additions. In Kannada nonword repetition task, both the groups had lesser substitution errors at three syllable length followed by two syllable length and then four syllable lengths. English nonword repetition task revealed lesser syllable substitution errors at two syllable followed by three and four syllable length. Finally the overall results indicated that the accuracy of the response on the NWR task in each language was related to performance on the corresponding language test.

CHAPTER V

SUMMARY AND CONCLUSIONS

Language and cognition are two interrelated terms which are inevitable in the field of speech-language pathology. Existence of a strong relationship between emergence of language and the cognitive development in a child is proven and well documented in the literature. Acquisition of two languages and the cognitive mechanism is being extensively explored by researchers.

Bilingualism is the ability of a person to express his thoughts, ideas and needs in two languages. Based on the age of acquisition, bilingualism is classified as early bilingualism and late bilingualism. Early bilinguals were classified as simultaneous and sequential bilingualism. If a child learns two languages at the same time, it is considered as simultaneous acquisition of two languages. The simultaneous acquisition occurs early in childhood, before the linguistic foundations of language are in place. They are considered to be learning a second language prior to full grammatical development of the first and therefore the two developing systems will interact more actively. If the child acquires one language and after the mastery in that language, learns a second language, it is termed as sequential bilingual. The child who is introduced to a second language before the age of three years was regarded as simultaneous bilingual and the child who is introduced to a second language after the age of three years of age was considered as sequential. The cognitive abilities of a child who is learning or who has already learned a second language would be different from a child who has competency in one language. Similarly the simultaneous bilinguals could differ from the sequential bilingual in many ways especially in terms of their cognitive abilities. Therefore researchers are trying to explore the relationship between bilingualism and cognition.

Working memory is one aspect of cognition that has been emphasized in studying language related cognitive functions in bilinguals. Bialystok (2009) stated that bilingual children exhibit advantage in working memory. A component of working memory called phonological working memory (PWM) has been studied extensively by researchers. PWM refers to a process of receiving, analyzing and processing sound elements in language. Baddeley's model highlights importance of PWM in learning new words whose unique phoneme sequence must be retained long enough to be assigned a semantic representation. Several other researchers have also emphasized the role of PWM in the learning of sounds of new words and thereby reading and vocabulary learning

Nonword repetition task is often used to investigate the PWM mechanism underlying language learning in children. In this task, children repeat increasingly longer nonwords comprising of syllables that conform to the phonotactic constraints of the target language. According to Gathercole and Baddely (1996) the nonword repetition (NWR) test is found to be useful as a screening tool because of the lesser administration time involved compared to other measures. Nonword difficulty was also found to increase as a function of nonword length in syllables across a number of languages

Several studies have been carried out to assess the PWM using a NWR task in monolingual and bilingual population. Bilinguals could have varying levels of exposure and experience in each language, as a result of which they could have varying levels of language knowledge. Consequently this could result in unique relationship between the cognitive processes underlying language learning such as phonological short term memory and levels of language knowledge. This speculation prompted the researchers to investigate the PWM in both their languages. Moreover the current literature evidence emphasizes that the language structure plays an important role in determining the phonological processing skills. Attempts have also been made to explore the PWM in different types of bilingual such as simultaneous and sequential bilinguals. This again could be a consequence to the realization that the pattern of language acquisition could possibly influence the PWM. However such studies are very limited and have been primarily carried out in the western population. Thus the present study was taken up to compare the phonological working memory of seven to eight year old simultaneous and sequential bilingual children in their first and second language using a nonword repetition task.

A total of twenty two simultaneous and twenty two sequential Kannada-English bilingual children in the age range of seven to eight years participated in the study. The simultaneous bilingual children were the ones who acquired Kannada and English simultaneously before the age of three years and the sequential bilinguals were the ones who acquired Kannada first and acquired English once they entered school after three years of age. The questionnaire developed by Harini and Chengappa (2010) which was further modified was used to classify them into these categories. They were matched on the socioeconomic status, gender and language proficiency. Simultaneous bilinguals had a proficiency rating of three and sequential bilinguals had a proficiency rating of two on the International Second Language Proficiency Rating Scale (ISLPR) (Ingram, 1985).

Participants who belonged to socioeconomic status of SES III to SES V in the various sections of the scale were considered for the study. To evaluate and match them on the language abilities in Kannada, semantic and syntactic sections of the Linguistic Profile Test in Kannada (LPT, Karanth, Ahuja, Nagaraja, Pandit, & Shivashankar, 1991) was administered. Sequential bilingual children had obtained a mean raw score of 147.05 and simultaneous bilingual children had obtained a mean raw score of 145.73. To evaluate and match them on the language abilities in English, English Language Test for Indian Children (Bhuvaneshwari & Jayashree, 2010) was administered. Sequential and simultaneous bilingual children had obtained mean overall raw scores of 132.25 and 148.84 respectively. They had age appropriate linguistic abilities in both languages.

A list of thirty nonwords in Kannada (ten in each of the syllable length) from the 'Word and Nonword Repetition Test in Kannada' (NWRT-K, Swapna & Shylaja, 2012) and a prepared list consisting of thirty nonwords in English (ten in each syllable length) were used as the stimuli. The bilingual children were asked to carefully listen and repeat the words in the same way as they hear. The stimuli were presented through headphones using a laptop computer and the responses of the children were audio recorded. This was further transcribed, scored and subjected to statistical analysis using SPSS version 17. Test-retest reliability was also determined for 50% of the bilingual children in each group.

The analysis of the scores on the NWR task was carried out based on accuracy of responses and error analysis across sequential and simultaneous bilingual children and across languages (Kannada & English) at on two, three and four syllable length.

Substitution, additions and omissions were considered for error analysis across different syllable length. The percentage of vowels and consonants correct was also analyzed.

The mean overall scores for the accuracy revealed a language specific performance by sequential and simultaneous bilingual group. Simultaneous bilingual children showed a superior performance over sequential bilingual children. Similar performance was exhibited by both the groups in their native language and simultaneous bilinguals outperformed the sequential bilingual children on the NWR task in their second language. There was a language specific performance by sequential bilinguals with superior performance on NWR in Kannada.

The results obtained for the accuracy of response with respect to syllable length also showed language specific performance i.e., both groups maintained similar pattern of performance in each language across syllable length. In English NWR task, difficulty increased as the syllable length increased. In Kannada NWR tasks, accuracy was higher at the three syllable length compared to the two syllable length. This result could be attributed to the perceptual salience effect explained by Bates and MacWhinney (1987) and result was also consistent with the study done by Lee, Kim, and Yim (2013).

There was a simultaneous bilingual advantage over sequential bilinguals on percentage of vowels and consonants correct. Total PVC was higher for simultaneous bilingual group compared to sequential bilingual group and higher mean value was obtained for Kannada NWR task compared to the English NWR task. It was found that in simultaneous and sequential bilinguals PVC scores decreased with increase in syllable length for nonword repetition in English. Highest percentage of consonant correct was obtained for English NWR for simultaneous bilingual children and the sequential bilingual children scored equally with respect to the PCC for the Kannada and the English NWR task.

Substitution errors were more compared to omissions and additions. In Kannada nonword repetition task, both the groups had less substitution errors at three syllable length followed by two syllable length and four syllable lengths. English nonword repetition task revealed lesser syllable substitution errors at two syllable followed by three and four syllable length. Finally, when comparing mean language scores obtained on the Kannada and English language test with the overall accuracy score on NWR tasks in both languages, it was found that greater language scores in a language implied better performance on the NWR task in that particular language. Percentage of syllable omission and percentage of syllable additions were not evaluated for the significant difference between groups as the median was zero and the standard deviation value was very high.

To conclude, the present study showed superior phonological memory capacity in simultaneous bilingual children compared to the sequential bilingual children using a nonword repetition task. The results also revealed a language specific NWR performance, i.e. the children performed better on the NWR task in the language in which they had better and deeper knowledge of the semantic and syntactic components. The present study therefore emphasizes the importance of language specific assessment of bilingual children which adds on to earlier literature pointing to the need for bilingual approach of cognitive and linguistic assessments.

Implications of the study

The present study gives an insight to the effect of simultaneous and sequential acquisition of languages on phonological working memory and also into the importance of knowing the working memory capacity of a bilingual child in each language. This study has certain clinical implications too. It provides an insight into the importance of knowing the age of acquisition of a child with language impairment or a child with less academic performance. Depending on the type of bilingualism, it is necessary to assess the cognitive linguistic skills in both the first and second language of a child. This study highlights the importance of use of nonword repetition as an assessment tool and incorporating the nonwords as stimuli for improving the phonological memory skills in the therapy program. Incorporating activities in both languages may promote better phonological working memory abilities, which may also improve their ability to phonologically encode and represent novel and non language material which would in turn improve the overall processing abilities. The findings of such research might also contribute to theories related to bilingualism.

Future Directions

Further research can be done in the Indian scenario on developing norms for nonword repetition ability in different languages. There is a need to compare the PWM capacities of bilingual and multilingual children of younger and older age group in their native language. Present study can be extended to the assessment of PWM in other variations of bilingualism such as balanced, dominant, and passive bilinguals. Further a language specific assessment on PWM can be done in bilingual children with different communication disorders.

REFERENCES

Adams, M. J. (1990). *Beginning to Read: Thinking and Learning about Print.* Cambridge, MA: MIT Press.

Alloway, T. P., & Gathercole, S. E. (2006). How does working memory work in the classroom? *Educational Research and Reviews, 1*(4), 134-139.

Alloway, T. P., Gathercole, S. E., Adams, M. A., Willis, C., Eaglen, R., & Lamont, E. (2005). Working memory and phonological awareness as predictors of progress towards early learning goals at school entry. *British Journal of Developmental Psychology, 23,* 417-426.

Alloway, T. P., Gathercole, S. E., Willis, C., & Adams, M. A. (2004). A structural analysis of working memory and related cognitive skills in young children. *Journal of Experimental Child Psychology, 87* (2), 85-106.

Alt, M. (2010). Phonological working memory impairments in children with specific language impairment: where does the problem lie? *Journal of Communication Disorders, 44*,173-185.

Anuroopa, L., & Chengappa, S. (2008). *Development of cognitive linguistic assessment protocol for children*. Student Research at AIISH Mysore (Articles based on dissertation done at AIISH), Vol: IV, Part B, 1-9.

Ardila, A. (2003). Language representation and working memory with bilinguals. *Journal of Communication Disorders, 36* (3), 233- 240.

Baddeley, A. D. (1986). *Working Memory.* New York: Clarendon/Oxford University Press.

Baddeley, A. D. (1990). *Human memory: Theory and practice.* London: Lawrence Erlbaum Associates.

Baddeley, A. D. (1996). Exploring the central executive. *The Quarterly Journal of Experimental Psychology, 49*A, 5-28.

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Science*, *4*, 417- 423.

Baddeley, A. D. (2003). Working memory and language: an overview. *Journal of Communications Disorders, 36*, 189- 208.

Baddeley, A., Emslie, H., Kolodny, J., & Duncan, J. (1998). Random generation and executive control of working memory. *The quarterly Journal of Experimental Psychology*, *51* (4), 819- 852.

Baddeley, A. D., Gathercole, S. E., & Papagno, C. (1998). The phonological loop as a language learning device. *Psychological Review*, *105*, 158- 173.

Bates, E., & MacWhinney, B. (1987). Competition, variation, and language learning. In B. MacWhinney (Eds.), Mechanisms of language acquisition. (pp. 157 – 193). Hillsdale, NJ: Erlbaum.

Ben-Zeev, S. (1977). The influence of bilingualism on cognitive strategy and cognitive development. *Child Development, 48*, 1009- 1018.

Best, J. B. (1999). *Cognitive psychology* (5th ed). Belmont: Woodsworth publishing company.

Bhuvaneshwari, N. M., & Jayashree, S. (2010). *English Language Test for Indian Children.* Student research at AIISH, Mysore (articles based on dissertation done at AIISH), Vol. VIII, Part B, 182- 189.

Bialystok, E. (1991). *Language processing in bilingual children*. Cambridge university press.

Bialystok, E., (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70* (3), 636-644.

Bialystok, E. (2005). *Consequences of bilingualism for cognitive development*. New York, Oxford University Press.

Bialystok, E. (2009). Do bilingual children show an advantage in working? *Cognitive Psychology Paper,* 1- 41.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging and cognitive control: Evidences from the Simon task. *Psychology and Aging,* 19, 290-303.

Bialystok, E., Craik, F. I. M., & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34,* 859–873. doi:10.1037/0278-7393.34.4.859.

Bialystok, E., Craik, F. I. M., & Ryan, J. (2006). Executive control in a modified anti-saccade task: Effects of aging and bilingualism. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *32,* 1341–1354

Bialystok, E., & Feng, X. (2009). Language proficiency and executive control in proactive interference: Evidence from monolingual and bilingual children and adults. *Brain and Language, 109*, 93–100.

Bialystok, E., Majumder, S., & Martin, M. M. (2003). Developing phonological awareness: is there a bilingual advantage? *Applied Psycholinguistics*, *24*, 27- 44.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition, 112* (3); 494-500.

Bloomfield, L. (1933). Definition of bilingualism. In J. F. Hammers & M. H. Blanc (2000). *Bilinguality and Bilingualism*. Cambridge university press.

Bortolini, U., Arfe, B., Caselli, M. C., Degasperi, L., Deevy, P., & Leonard, L. B. (2006). Clinical markers for specific language in Italian: the contribution of clitic and nonword repetition. *International Journal of Communication Disorders*, *41,* 695-712.

Bowey, J. A. (1996). On the association between phonological memory and receptive vocabulary in five years old. *Journal of Experimental Child Psychology*, *63*, 44-78.

Bowey, J. A. (1997). What does nonword repetition measure? A reply to Gathercole and Baddely. *Journal of Experimental Child Psychology*, *67*, 295- 301.

Bradley, L., & Bryant, P. E. (1985). *Rhyme and reason in reading and spelling.* Michigan: University of Michigan Press.

Bruck, M., & Genesee, F. (1995). Phonological awareness in young second language learners. *Journal of Child Psychology, 22,* 307-324.

Campbell, T., Dollaghan, C., Needleman, H., & Janosky, J. (1997). Reducing bias in language assessment. Processing-dependent measures. *Journal of Speech, Language and Hearing Research, 40* (3), 519-525.

Carlson, M. S., & Meltzoff, N. A. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11*(2), 282-298.

Christoffels, I. K., & de Groot, A. M. B. (2005). Simultaneous interpreting: A cognitive perspective. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 454–479). New York: Oxford University Press.

Coady, J., & Evans, J. (2007). Uses and interpretation of nonword repetition tasks in children with and without specific language impairment. *International Journal of Language and Communication Disorders, 43* (1), 1-40.

Colom, R., Rebollo, I., Palacios, A., Juan-Espinosa, M., & Kyllonen, P. C. (2004). Working memory is (almost) perfectly predicted by *g*. *Intelligence, 32* (3), 277-296.

Cook, V. (1997). The consequence of bilingualism for cognitive processing. In A. M. B. Be Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism: Psycholingusitic perspectives* (pp. 279- 299). Mahwah, NJ: Lawrence Erlbaum associates Inc.

Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *Journal of Child Psychology & Psychiatry, Allied Disciplines, 42* (6), 741-748.

Cummins, J. (1976). The influence of bilingualism on cognitive growth: A synthesis of research findings and explanatory hypothesis. *Working Papers on Bilingualism no: 9.*

Cummins, J. (1979). Linguistic interdependence and the educational placement of bilingual children. *Review of Educational Research, 49* (2), 222-251.

Cummins, J., & Gulutsan, M. (1974). Some effects of bilingualism on cognitive functioning. In S. T. Carey (Eds.), *Bilingualism, Biculturalism, and Education.* Proceedings of the conference at college universitaire Saint-Jean, The University of Alberta, Canada.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, 19, 450–466.

Deepa, A., & Savithri, S. R. (2012). Restandardization of Kannada Articulation Test. Student research at AIISH, Mysore (articles based on dissertation done at AIISH), Vol. VIII, Part B, 53- 65.

Dollaghon, C., Bibes, M., & Cambel, T. (1995). Lexical influences on nonword repetition. *Applied Psycholinguistics,* 16, 211-222.

Ellis Weismer, S., Tomblin, J., Zhang, X., Buckwalter, P., Chynoweth, J., & Jones, M. (2000). Nonword repetition performance in school-age children with and without language impairment. *Journal of Speech, Language, and Hearing Research, 43*, 856-878.

Engel de Abreu, P.M.J. (2011). Working memory in multilingual children: Is there a bilingual effect? *Memory, 19*, 529-537.

Fardeau, O. (1993). Franco-italian bilingualism in early childhood and cognitive development. [Bilinguisme precoce franco-italien et developpement cognitif] ***Il Forneri,*** 7(2), 83-99. From Linguistics and Language Behavior Abstracts database. (http://www.actfl.org/advocacy/discover-languages/advocacy/discover-languages /what-the-research-shows/references-cognitive)

Frisch, S. A., Large, N. R., & Pisoni, D. B. (2000). Perception of wordlikeness: effects of segment probability and length on the processing of nonwords. *Journal of Memory and Language, 42*, 481- 496.

Gathercole, S. E. (1995). The assessment of phonological memory skills in preschool children. *British Journal of Educational Psychology, 65*, 155- 164.

Gathercole, S. E. (1999). Cognitive approaches to the development of short-term memory. *Trends in Cognitive Sciences, 3*, 410-419.

Gathercole, S. E. (2006). Nonword repetition and word learning: the nature of the relationship. *Applied Psycholinguistics*, *27*, 513- 543.

Gathercole, S. E., & Alloway, T. P. (2004). Working memory and classroom learning. *Dyslexia Review, 15*, 4-9.

Gathercole, S. E., Alloway, T. P., Willis, C., & Adams, A. M. (2006). Working memory in children with reading disabilities. *Journal of Experimental Child Psychology, 9,* 265-281.

Gathercole, S. E., & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of Memory and Language, 28*, 200- 213.

Gathercole, S. E., & Baddeley, A. D. (1990). The role of phonological memory in vocabulary acquisition: A study of young children learning new words. *British Journal of Psychology, 81*, 439- 454.

Gathercole, S. E., & Baddeley, A. D. (1996). *The Children's Test of Nonword Repetition.* London: Psychological corporation.

Gathercole, S. E., Willis, C. S., & Emslie, S. H., Baddeley, A. D. (1991). The influences of number of syllables and wordlikeness on children's repetition of nonwords. *Applied Psycholinguistics, 12*, 349- 367.

Gathercole, S. E., Willis, C. S., & Emslie, S. H., Baddeley, A. D. (1992). Phonological memory and vocabulary development during the early years: a longitudinal study. *Developmental Psychology, 28*, 887- 898.

Genesse, F., Hamers, J., Lambert, W. E., Mononen, L., Seitz, M., & Starck, R. (1978). Language processing in bilingualism. *Brain and Language, 5*, 1-12.

Gijsel, M. A. R., Bosman, A. M. T., & Verhoeven, L. (2006). Kindergarten risk factors, cognitive factors, and teacher judgments as predictors of early reading in Dutch. *Journal of Learning Disabilities, 39*, 558- 571.

Girbau, D., & Schwartz, R. G. (2007). Nonword repetition in Spanish-speaking children with specific language impairment (SLI). *International Journal of Language and Communication Disorders*, *42*, 59- 75.

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*, 1122- 1139.

Grosjean, F. (1998). Studying bilinguals: Methodological and conceptual issues. Bilingualism. *Language and cognition*, *1*(2), 131- 149.

Gupta, P. (2003). Examining the relationship between word learning, nonword repetition, and immediate serial recall in adults. *Quarterly Journal of Experimental Psychology, 56* (A), 1213-1236.

Gutierrez-Clellen., & Simon-Cereijido, G. (2010). Using nonword repetition tasks for the identification of language impairment in Spanish-English speaking children: Does the language assessment matter? *Learning Disabilities Research and Practice, 25* (1), 48-58.

Hakuta, K., & Diaz, R. (1985). The relationship between degree of bilingualism and cognitive ability: A critical discussion and some new longitudinal data. In K. E. Nelson (Eds.) *Children's language* (Vol.5, pp. 319-344). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Harley, T. A. (2001). *The psychology of language: from data to theory*. Psychology press Ltd.

Harini, N. V., & Chengappa, S. (2010). Code mixing and code switching in simultaneous and successive bilingual children. Student research at AIISH Mysore (article based dissertation done at AIISH), Vol 6, Part B, 97- 115.

Hemakumar, G. (2011). Acoustic phonetic characteristics of Kannada language. *International Journal of Computer Science, 8*(6), 332-339.

Hoff, E., & McKay, J. (2005). Phonological memory skill in monolingual and bilingual 23- Month-Olds. In J. Cohen, K. McAlister, K. Rolstad., & J. MacSwan (Eds.) ISB4*: Proceedings of the fourth international symposium on Bilingualism* (pp. 1041-1044). Somerville, MA: Cascadilla Press.

Homel, P., Palij, M., & Aaronson, D. (1987). *Childhood Bilingualism: Aspects of linguistic, cognitive and social development.* Lawrence Erlbaum Associates, Inc.

Ingram, E. D. (1985). How native like? Measuring language proficiency in bilinguals. *Journal of Applied Linguistics, XI* (2), 47- 64.

Karanth, P., Ahuja, G. K., Nagaraja, D., Pandit, R., & Shivashankar, N. (1991). *Language disorders in Indian neurological patients- A study in neurolinguistic in Indian context.* (Project No. 5/8/10 (Oto)/84- NCD- IIRIS cell). New Delhi: (Indian Counsel of Medical Research 8403810).

Karanth, P., Manjula, R., Geetha, Y. V., & Prema, K. S. (1999). *With a little bit of help- Early language training manual.* Books for change, Bangalore.

Kaushanskaya, M., Blumenfeld, H. K., & Marian, V. (2011). The relationship between vocabulary and short-term memory measures in monolingual and bilingual speakers. *International Journal of Bilingualism, 15*, 408-425.

Kaushanskaya, M., & Marian, V. (2009). Bilingualism reduces native language interferences in novel word learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*, 829-835.

Kaushanskaya, M., & Yoo, J. (2012). Phonological short term and working memory in bilinguals' native and second language. *Applied Psycholinguistics,* 1-33. Doi:10.1017/ S01427164120000100.

Kessler, C., & Quinn, M. E. (1987). Language minority children's linguistic and cognitive creativity. *Journal of Multilingual and Multicultural Development*, *8*, 173-186.

Klein, D., Watkins, K. E., Zatorre, R. J., & Milner, B. (2006). Word and nonword repetition in bilingual subjects: a PET study. *Human Brain Mapping, 27,* 153-161.

Kormi-Nouri, R., Moniri, S., & Nilsson, L.G. (2003). Episode and semantic memory in bilingualism and monolingualism children. *Scandinavian Journal of Psychology, 44*(1), 47-54.

Lee, S. A. S., & Gorman, B. K., (2012). Nonword repetition performance and related factors in children representing four linguistic groups. *International Journal of Bilingualism,* published online 4 April 2012.

Lee, H. J., Kim, Y. T., & Yim. D. (2013). Non-word repetition performance in Korean-English bilingual children. *International Journal of Speech-Language Pathology*, 1-8.

Lesaux, N. K., & Siegel, L.S. (2003). The development of reading in children who speak English as a second language. *Developmental Psychology, 39*(6), 1005-1019.

Logie, R. H. (1995). *Visuospatial working memory.* Erlbaum.

Majerus, S., Poncelet, M., Elsen, B., & Van der Linden. (2006). Exploring the relationship between new word learning and short term memory for serial order recall, item recall, and item recognition. *European Journal of Cognitive Psychology, 18*, 843- 873.

Masoura, E. V., & Gathercole, S. E. (1999). Phonological short-term memory and foreign language learning. *International Journal of Psychology, 34*, 383-388.

Masoura, E. V., & Gathercole, S. E. (2005). Contrasting contributions of phonological short term memory and long term knowledge to vocabulary learning in a foreign language. *Memory*, *13*, 422- 429.

McBride-Chang, C. (1995). What is phonological awareness? *Journal of Educational Psychology, 87*(2), 179-192.

McKay, J., & Hoff, E. (2005). Phonological Memory skill in monolingual and bilingual twenty three month olds. Proceedings of the 4th International Symposium on Bilingualism, ed. James Cohen, Kara T. McAlister, Kellie Rolstad, and Jeff MacSwan, 1041-1044. Somerville, MA: Cascadilla Press.

McLaughlin, B. (1978). *Second language acquisition in childhood*. New Jersey Laurence Erlbaum associates publishers.

Messer, M., Leseman, P., Boom, J., & Mayo, A. (2010). Phonotactic probability effect in nonword recall and its relationship with vocabulary in monolingual and bilingual preschoolers. *Journal of Experimental Child Psychology*, *105*(4), 306–323.

Michas, I., & Henry, L. A. (1994). The link between phonological memory and vocabulary acquisition. *British Journal of Developmental Psychology, 12,* 147-163.

Miettinen, H. (2012). Phonological Working Memory and L2 Knowledge: Finnish children learning English. Dissertation submitted to University of Jyvaskyla, *University of Jyvaskyla.*

Montogomery, J. (2000). Verbal working memory and sentence comprehensionin children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *43*, 293-308.

Nair, V., Mathew, J., Bhat, S., & Demuth, K. (2012). Effects of bilingualism on novel word learning. *Paper presented at the international conference on Bilingualism and Comparative Linguistics. Chinese University of Hong Kong, Maliv Shrui, Hong Kong.*

Neisser, U. (1976). *Cognition and reality*: *Principles and implications of cognitive psychology.* San Francisco, CA: William H. Freeman.

Oakhill, J., & Kyle, F. (2000). The relation between working memory and phonological awareness. *Journal of Experimental Child Psychology, 75*, 152-164.

Oetting, J. B., & Cleveland, L. H. (2006). The clinical utility of nonword repetition for children living in the rural south of the US. *Clinical Linguistics & Phonetics, 20*, 553-561.

Parra, M., Hoff, E., & Core, C. (2011). Relation among language exposure, phonological memory, and language development in Spanish-English bilingually developing two year olds. *Journal of Experimental Psychology, 108* (1), 113- 125.

Pearl, E., & Lambert, W. E. (1962). The relation of bilingualism to intelligence. *Psychological Monographs*, *76* (27, Whole no. 546).

Pena, E., & Bedore, L. (2009). Bilingualism in child language disorders. In R. G. Schwartz (Eds.), *Handbook of child language disorders* (pp. 281-307). New York, NY: Psychology Press.

Radeborg, K., Barthelom, E., Sjoberg, M., & Sahlen, B. (2006). A swedish nonword repetition test for preschool children. *Scandinavian Journal of Psychology*, *47*, 187- 192.

Ricciardelli, L. A. (1992). Bilingualism and cognitive development in relation to threshold theory. *Journal of Psycholinguistic Research, 21*, 301–316.

Rodekohr, R. K., & Haynes, W. O. (2001). Differentiating dialect from disorder: A comparison of two processing tasks and a standardized language test. *Journal of Communication Disorders*, *34*, 255-272.

Sadock, B. J., Sadock, V. A., & Pipino, L.L. (2007). Kaplan and Sadock's synopsis of psychiatry: Behavioral sciences. Lippincott Williams and Wilkins.

Sangeetha, G. S., & Swapna, N. (2011). *Cognitive linguistic abilities in simultaneous and sequential bilingual children.* Student research at AIISH, Mysore (articles based on dissertation done at AIISH), Vol. IX, Part B, 217- 229.

Seeff-Gabriel, B., Chiat, S., & Roy, P. (2008). *Early Repetition Battery*. Pearson Education Inc.

Service, E. (1992). Phonology, working memory, and foreign language learning. *The Quarterly Journal of Experimental Psychology, 45A* (1), 21- 50.

Service, E., & Kohenen, V. (1995). Is the relation between memory and foreign language learning accounted for by vocabulary acquisition? *Applied Psycholinguist, 16*, 155- 172.

Shabani, M. B., & Sarem, S.N. (2008). The study of learning strategies used by male/ female monolingual and bilingual speakers as EFL learners. *ELT Weekly*, 15.

Shylaja, K., Abraham, A., Thomas, G. L., & Swapna, N. (2011). Nonword repetition in simultaneous and sequential bilinguals. *Journal of All India Institute of Speech and Hearing, 30,* 176-184.

Siegel, L. S. (1994). Working memory and reading: A life-span perspective. *International Journal of Behavioural Development, 17,* 109-124.

Simkin, Z., & Conti-Ramsden, G. (2001). Nonword repetition and grammatical morphology: normative data for children in their year of primary school. *International Journal of Language and Communication Disorders,* 36 (3), 395-404.

Singhi, P., Kumar, M., Malhi, P., & Kumar, R. (2007). Utility of the WHO ten questions screen for disability detection in rural community-the North Indian experience. *Journal of Tropical Pediatrics*, 53 (6), 383- 387.

Smith, S., Mann, V. A., & Shankweiler, D. (1986). Spoken sentence comprehension in good and poor readers: a study with the token test. *Cortex, 22*, 627–632.

Snow, C. E. (1993). *Bilingualism and second language acquisition*. In J. Berko Gleason & N. Bernstein Ratner (Eds.), Psycholinguistics (pp. 391-416). New York: Harcourt Brace.

Stephens, S., Sindhupriya., Mathur, R., & Swapna, N.(2010). Cognitive linguistic abilities in bilingual children. *Journal of All India Institute of Speech and Hearing, 29*(1), 1-11.

Summers, C., Bohman, T. M., Gilliam, R. B., & Bedore, L. M. (2010). Bilingual performance on nonword repetition in Spanish and English. *International Journal of Language Communication Disorders, 36* (3), 395- 404.

Swanson, H. L., & Berninger, V. (1995). The role of working memory in skilled and less skilled readers' comprehension. *Intelligence, 21*, 83–108.

Swapna, N., & Shylaja, K. (2012). *Word and Non word repetition test in Kannada (WNRT- K)*. A publication of the All India Institute of Speech and Hearing, Mysore.

Thorn, A. S, C., & Gathercole, S. E. (1999). Language specific knowledge and short-term memory in bilingual and non bilingual children. *Quarterly Journal of Experimental Psychology, 52A*, 303-324.

Vallar, G., & Baddeley, A. D. (1984). Fractionation of working memory. Neuropsychological evidence for phonological short-term store. *Journal of Verbal Learning and Verbal Behavior,* I23, 151-162.

Webster dictionary (1961). Definition of Bilingualism. In J. F. Hammers & M. H. Blanc (2000). *Bilinguality and Bilingualism*. Cambridge university press.

Weinreich, U. (1953). *Languages in contact.* New York Linguistic circle of New York.

Windsor, J., Kohnert., Lobitz, K. F., & Pham, G. T. (2010). Cross language nonword repetition by bilingual children and monolingual children. *American Journal of Speech-Language Pathology, 19,* 298- 310.

Wodniecka, Z., Craik, F. I. M., Luo, L., & Bialystok, E. (2010). Does bilingualism help memory? Competing effects of verbal ability and executive control. *International Journal of Bilingual Education and Bilingualism*, *13 (5)*, 575-595.

Valdes, G., & Figueora, R. (1994). Bilingualism and testing: A special case of bias. *Applied Psycholinguistics, 21* (2), 290-296.

Venkatesan, S. (2011). Readapted from 1997 version. NIMH Socio Economic Status Scale. Secunderabad: National Institute for the Mentally Handicapped.

Yoo, J., & Kaushanskaya, M. (2012). Phonological memory in bilinguals and monolinguals. *Memory and Cognition, 40*, 1314-1330.

APPENDIX V: ENGLISH NONWORD SCORE SHEET

Practice Items	No. of presentations	Discontinue Rule	Accuracy and Error analysis
1. /pɑ:hI/ 2. /dohıle/ 3. /dɑnferwʊl/ 4. //lartIcʊpɑr/ 5. /no:rfʊletI/	If the child doesnot respond to a practice item allow up to two further presentations	None: attempt to administer all items.	Calculate a) Accuracy- i) total number of nonwords correct and also number of nonwords correct at each syllable length ii)total number and the percentage of vowels and consonants correct b) Error analysis- total number and the percentage of syllable substitutions, omissions and additions. All the measures should be calculated at each of the syllable length and overall nonword test items.

- Circle / tick ‘1’ if the child repeats correctly, with all phonemes of the target present in the correct order (allowing for only systematic/ consistent substation due to phonological processes and dialectal influences).
- Circle/ tick ‘0’ if the response is not a correct repetition.
- Circle/ tick ‘NR’ if the child refuses to attempt a repetition.

No	Target	Score			Transcription	Score by items length			No. Vowels correct			No. Consonants correct		
		1	0	NR		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.	/dute/	1	0	NR	/dute/	1			2			2		
2.	/tarɑke/	1	0	NR	/tarɑke/		1			3			3	
3	/ʃo:mpetıken/	1	0	NR	/ʃo:mpetıken/			1			3			6
4.	/gɑ:nmo/	1	0	NR	/gɑ:nmo/	1			2			3		
5.	/tesderje/	1	0	NR	/testerje/		0			3			4	
6.	tɑmerwelen/	1	0	NR	/tɑmerwelen/			1			4			6
7.	/ko:ndı/	1	0	NR	/ko:ndı/	1			2			3		
8.	/marɛkɑ/	1	0	NR	/marɛkɑ/		1			3			3	
9.	/rısvɑdekı/	1	0	NR	/rısvɑdekı/			1			4			5
10.	/nɑmı/	1	0	NR	/nɑmı/	1			2			2		
11.	/raŋaku/	1	0	NR	/raŋaku/		1			3			3	
12.	/laıkobʊnɑr/	1	0	NR	/laıkobʊnɑr/			1			4			5
13.	/lɑker/	1	0	NR	/lɑkɛ:/	0			2			2		
14.	/nımesɑ/	1	0	NR	/nımesɑ/		1			3			2	
15.	/kesʊtırı/	1	0	NR	/kesʊtırı/			1			4			4
16.	/gınfer/	1	0	NR	/gınfer/	1			2			4		
17.	/tarɑker/	1	0	NR	/tarɑker/		1			3			4	
18	/remtepɛʧar/	1	0	NR	/remtepɛʧar/			1			4			6
19.	/dınvo/	1	0	NR	/dınvo/	1			2			3		
20	/rubemɑ:ŋ/	1	0	NR	/rubemɑ:ŋ/		1			3			4	
21.	/no:mʃIbeken/	1	0	NR	/no:mʃIbeken/			1			4			6
22.	/dɑ:rgen/	1	0	NR	/dɑ:rgen/	1			2			4		
23.	/kolnɑ:vo/	1	0	NR	/kolnɑ:vo/		1			3			4	
24.	/dʒatomırı/	1	0	NR	/dʒatomerı/			0			3			4
25.	/kelwɑm/	1	0	NR	/kelwɑm/	1			2			4		
26.	/rımɑpıd/	1	0	NR	/rımɑpıd/		1			3			4	
27.	/tırılamı/	1	0	NR	/ tıvılamı/			0			4			3
28.	/nekel/	1	0	NR	/nekel/	1			2			3		
29.	/dɑ:rneger/	1	0	NR	/dɑ:rneger/		1			3			5	
30.	/dıntergarken/	1	0	NR	/dıntelgarken/			0			4			7
	Nonword total				25/30	9/10	9/10	7/10	20/20	30/30	38/40	28 /31	36/38	52/54
									100%	100%	95%	90.3%	94%	96.%
					83.33%	90%	90%	70%	88 /90			116 /123		
									%			%		

NONWORD SCORE SHEET: TYPES OF SYLLABLE ERRORS

No	Nonwords Transcribed	No. Syllable substitutions			No. Syllable omissions			No. of syllable additions		
		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.	/dute/	0								
2.										
3										
4.										
5.	/testerje/		1							
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.	/lɑke/				1					
14.										
15.										
16.										
17.										
18										
19.										
20										
21.										
22.										
23.										
24.	/dʒɑtomerɪ/			1						
25.										
26.										
27.	/ tɪvɪlɑmɪ/			1						
28.										
29.										
30.	/dɪntelgɑrken /			1						
		0/20	1/30	3/40	1/20	/30	/40	/20	/30	/40
			3.33%	7.5%	5%					

APPENDIX IV: KANNADA NONWORD SCORE SHEET

Practice Items	No. of presentations	Discontinue Rule	Accuracy and Error analysis
1. /t̪eṭṭa/ 2. /n̪al̪uvi/ 3. /va:bha:n̪ura/ 4. /l̪uṭṭiḷugame/ 5. /ṭa:baḷuṇiga/	If the child does not respond to a practice item allow up to two further presentations	None: attempt to administer all items.	Calculate a) Accuracy- i) total number of nonwords correct and also number of nonwords correct at each syllable length ii)total number and the percentage of vowels and consonants correct b) Error analysis- total number and the percentage of syllable substitutions, omissions and additions. All the measures should be calculated at each of the syllable length and overall nonword test items.

- Circle / tick '1' if the child repeats correctly, with all phonemes of the target present in the correct order (allowing for only systematic/ consistent substation due to phonological processes and dialectal influences).
- Circle/ tick '0' if the response is not a correct repetition.
- Circle/ tick 'NR' if the child refuses to attempt a repetition.

No	Target	Score			Transcription	Score by items length			No. Vowels correct			No. Consonants correct		
		1	0	NR		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.	/men̪a/	1	0	NR	/men̪a/	1			2			2		
2.	/l̪ippatʃa/	1	0	NR	/l̪ippatʃa/		1			3			3	
3	/raka:t̪ari/	1	0	NR	/raka:t̪ari/			1			4			4
4.	/tʃe:pa/	1	0	NR	/tʃe:pa/	1			2			2		
5.	/l̪et̪t̪aka/	1	0	NR	/met̪t̪aka/		0			3			2	
6.	/karasaga/	1	0	NR	/karasaka/			0			4			3
7.	/n̪o:l̪i/	1	0	NR	/n̪o:l̪i/	1			2			2		
8.	/l̪abat̪a/	1	0	NR	/l̪abat̪a/		1			3			3	
9.	/jal̪l̪in̪ema/	1	0	NR	/el̪l̪in̪ema/			0			3			3
10.	/d̪e:ra/	1	0	NR	/d̪e:ra/	1			2			2		
11.	/ḍikame/	1	0	NR	/ḍikame/		1			3			3	
12.	/pad̪i:gaḷu/	1	0	NR	/pad̪i:gaḷu/			1			4			4
13.	/bun̪n̪e/	1	0	NR	/bun̪n̪e/	1			2			2		
14.	/ḍikkat̪a/	1	0	NR	/ḍikkat̪a/		1			3			3	
15.	/gil̪ad̪ema/	1	0	NR	/gil̪ad̪ema/			1			4			4
16.	/mu: n̪i/	1	0	NR	/mu: n̪i/	1			2			2		
17.	/t̪ipa:tʃa/	1	0	NR	/t̪ipa:tʃa/		1			3			3	
18	/n̪iva:ʃara/	1	0	NR	/n̪iva:ʃara/			1			4			4
19.	/weḍa/	1	0	NR	/weḍa/	1			2			2		
20	/l̪ikkutʃa/	1	0	NR	/l̪ikkutʃa/		1			3			3	
21.	/maḷun̪ega/	1	0	NR	/maḷun̪eka/			0			4			3
22.	/d̪a:pi/	1	0	NR	/d̪a:pi/	1			2			2		
23.	/sabava/	1	0	NR	/sabava/		1			3			3	
24.	/gabi:ḷuga/	1	0	NR	/gabi:ḷuka/			0			4			3
25.	/ke:ga/	1	0	NR	/ke:ka/	0			2			1		
26.	/ʃaṇe:ga/	1	0	NR	/ʃaṇe:ga/		1			3			3	
27.	/gaḷebaḷu/	1	0	NR	/gaḷebaḷu/			1			4			4
28.	/bi:ja/	1	0	NR	/bi:ja/	1			2			2		
29.	/beḷura/	1	0	NR	/beḷura/		1			3			3	
30.	/maḷugara/	1	0	NR	/maḷugara/			1			4			4
	Nonword total				24/30	9/10	9/10	6/10	20/20	30/30	40/40	19/20	29/30	36/40
									100%	100%	100%	95%	96.7	90%
									90 /90			84/90		

					80%				100 %	93.33 %

NONWORD SCORE SHEET: TYPES OF SYLLABLE ERRORS

No	Nonwords Transcribed	No. Syllable substitutions			No. Syllable omissions			No. of syllable additions		
		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.										
2.										
3										
4.										
5.	/met̪t̪aka/		1							
6.	/karasaka/			1						
7.										
8.										
9.	/el̪l̪in̪ema/						1			
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18										
19.										
20										
21.	/maḷun̪eka			1						
22.										
23.										
24.	/gabi:ḷuka/			1						
25.	/ke:ka/	1								
26.										
27.										
28.										
29.										
30.										
		1/20	1/30	3/40	/20	/30	1/40	/20	/30	/40
		5%	3.33%	7.5%			2.5%			
		%			%			%		

APPENDIX III: ENGLISH NONWORD SCORE SHEET

Practice Items	No. of presentations	Discontinue Rule	Accuracy and Error analysis
1. /pɑ:hI/ 2. /dohɪle/ 3. /dɑnferwʊl/ 4. //lɑrtIcʊpɑr/ 5. /no:rfʊletI/	If the child doesnot respond to a practice item allow up to two further presentations	None: attempt to administer all items.	Calculate a) Accuracy- i) total number of nonwords correct and also number of nonwords correct at each syllable length ii)total number and the percentage of vowels and consonants correct b) Error analysis- total number and the percentage of syllable substitutions, omissions and additions. All the measures should be calculated at each of the syllable length and overall nonword test items.

- Circle / tick '1' if the child repeats correctly, with all phonemes of the target present in the correct order (allowing for only systematic/ consistent substation due to phonological processes and dialectal influences).
- Circle/ tick '0' if the response is not a correct repetition.
- Circle/ tick 'NR' if the child refuses to attempt a repetition.

No	Target	Score			Transcription	Score by items length			No. Vowels correct			No. Consonants correct		
		1	0	NR		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.	/dute/	1	0	NR										
2.	/tɑrɑke/	1	0	NR										
3	/ʃo:mpetɪken/	1	0	NR										
4.	/gɑ:nmo/	1	0	NR										
5.	/tesderje/	1	0	NR										
6.	tɑmerwelen/	1	0	NR										
7.	/ko:ndɪ/	1	0	NR										
8.	/mɑrɛkɑ/	1	0	NR										
9.	/rɪsvɑdekɪ/	1	0	NR										
10.	/nɑmɪ/	1	0	NR										
11.	/rɑŋaku	1	0	NR										
12.	/lɑɪkobʊnɑr/	1	0	NR										
13.	/lɑker/	1	0	NR										
14.	/nɪmesɑ/	1	0	NR										
15.	/kesʊtɪrɪ/	1	0	NR										
16.	/gɪnfer/	1	0	NR										
17.	/tɑrɑker/	1	0	NR										
18	/remtepɛʧɑr/	1	0	NR										
19.	/dɪnvo/	1	0	NR										
20	/rubemɑ:ŋ/	1	0	NR										
21.	/no:mʃIbeken/	1	0	NR										
22.	/dɑ:rgen/	1	0	NR										
23.	/kolnɑ:vo/	1	0	NR										
24.	/dʒatomɪrɪ/	1	0	NR										
25.	/kelwɑm/	1	0	NR										
26.	/rɪmɑpɪd/	1	0	NR										
27.	/tɪrɪlamɪ/	1	0	NR										
28.	/nekel/	1	0	NR										
29.	/dɑ:rneger/	1	0	NR										
30.	/dɪntergɑrken/	1	0	NR										
	Nonword total					/10	/10	/10	/20	/30	/40	/31	/38	/54
									%	%	%	%	%	%
									/90			/123		
									%			%		

NONWORD SCORE SHEET: TYPES OF SYLLABLE ERRORS

No	**Nonwords Transcribed**	**No. Syllable substitutions**			**No. Syllable omissions**			**No. of syllable additions**		
		2 Sy	**3 Sy**	**4sy**	**2 Sy**	**3Sy**	**4sy**	**2 Sy**	**3 Sy**	**4 Sy**
1.										
2.										
3										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18										
19.										
20										
21.										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										
		/20	/30	/40	/20	/30	/40	/20	/30	/40
		/90			/90			/90		
		%			%			%		

APPENDIX II: KANNADA NONWORD SCORE SHEET

Practice Items	No. of presentations	Discontinue Rule	Accuracy and Error analysis
1. /t̪eṭṭa/ 2. /n̪al̪uvi/ 3. /va:bha:n̪ura/ 4. /l̪uṭṭiḷugame/ 5. /ṭa:baḷuṇiga/	If the child does not respond to a practice item allow up to two further presentations	None: attempt to administer all items.	Calculate a) Accuracy- i) total number of nonwords correct and also number of nonwords correct at each syllable length ii)total number and the percentage of vowels and consonants correct b) Error analysis- total number and the percentage of syllable substitutions, omissions and additions. All the measures should be calculated at each of the syllable length and overall nonword test items.

- Circle / tick '1' if the child repeats correctly, with all phonemes of the target present in the correct order (allowing for only systematic/ consistent substation due to phonological processes and dialectal influences).
- Circle/ tick '0' if the response is not a correct repetition.
- Circle/ tick 'NR' if the child refuses to attempt a repetition.

No	Target	Score			Transcription	Score by items length			No. Vowels correct			No. Consonants correct		
		1	0	NR		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.	/men̪a/	1	0	NR										
2.	/l̪ippatʃa/	1	0	NR										
3	/raka:t̪ari/	1	0	NR										
4.	/tʃe:pa/	1	0	NR										
5.	/l̪et̪t̪aka/	1	0	NR										
6.	/karasaga/	1	0	NR										
7.	/n̪o:l̪i/	1	0	NR										
8.	/l̪abat̪a/	1	0	NR										
9.	/jal̪l̪in̪ema/	1	0	NR										
10.	/d̪e:ra/	1	0	NR										
11.	/ḍikame/	1	0	NR										
12.	/pad̪i:gaḷu/	1	0	NR										
13.	/bun̪n̪e/	1	0	NR										
14.	/ḍikkat̪a/	1	0	NR										
15.	/gil̪ad̪ema/	1	0	NR										
16.	/mu: n̪i/	1	0	NR										
17.	/t̪ipa:tʃa/	1	0	NR										
18	/n̪iva:ʃara/	1	0	NR										
19.	/weḍa/	1	0	NR										
20	/l̪ikkutʃa/	1	0	NR										
21.	/maḷun̪ega/	1	0	NR										
22.	/d̪a:pi/	1	0	NR										
23.	/Sabava/	1	0	NR										
24.	/gabi:ḷuga/	1	0	NR										
25.	/ke:ga/	1	0	NR										
26.	/ʃaṇe:ga/	1	0	NR										
27.	/gaḷebaḷu/	1	0	NR										
28.	/bi:ja/	1	0	NR										
29.	/beḷura/	1	0	NR										
30.	/maḷugara/	1	0	NR										
	Nonword total					/10	/10	/10	/20	/30	/40	/20	/30	/40
									%	%	%	%	%	%
									/90			/90		
									%			%		

NONWORD SCORE SHEET: TYPES OF SYLLABLE ERRORS

No	Nonwords Transcribed	No. Syllable substitutions			No. Syllable omissions			No. of syllable additions		
		2 Sy	3 Sy	4sy	2 Sy	3Sy	4sy	2 Sy	3 Sy	4 Sy
1.										
2.										
3										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18										
19.										
20										
21.										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										
		/20	/30	/40	/20	/30	/40	/20	/30	/40
		/90			/90			/90		
		%			%			%		