# NONWORD REPETITION IN SIMULTANEOUS AND SEQUENTIAL BILINGUALS

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**Abstract**

*Bilingualism is the process of knowing or using two languages with equal or nearly equal fluency. Research evidences have suggested that cognition is affected by the process of learning one or more languages. In this context the present study aimed at investigating the Phonological Working Memory (PWM), one of the language specific cognitive processing areas in different types of bilingual children. A Kannada based nonword repetition task (NWR) was administered to eight simultaneous and eight sequential Kannada-English bilingual children in the age range of seven to eight years. Their responses were audio recorded, transcribed, scored, and subjected to statistical analysis. The results indicated that the sequential bilingual children performed significantly better compared to the simultaneous bilinguals on 4-syllable, 5-syllable and on overall accuracy of nonword repetition task. Further error analysis indicated that the simultaneous bilingual children had more percentage of syllable substitutions and omission errors than sequential bilingual children. This suggested better phonological working memory skills 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 use of the first and second language. This study provides an insight into the phonological working memory skills in bilingual individuals who have acquired their languages in a different manner and the results could contribute to theories related to language processing in them.*

***Keywords:*** *phonological working memory, sequential bilinguals, simultaneous bilinguals*

Bilingualism is a language related phenomenon which is extremely prevalent in the present day scenario. The term *bilingual*, on the surface means knowledge of two languages. Individuals can acquire languages in a variety of ways at different points of time in their life and in a variety of circumstances and contexts. The extent of exposure to a particular language and its use also differs from person to person. Bilingualism therefore is not unitary or static phenomenon and is shaped by a variety of historical, cultural, political, economic, environmental, linguistic, psychological and other factors. Accordingly researchers are yet to arrive at a complete definition of bilingualism covering all the aspects. They have tried to classify bilinguals on the basis of age of acquisition of language, proficiency level of the languages and the context in which learning takes place. Consideration of the age of acquisition has given rise to several classifications from a developmental perspective. One such classification is simultaneous and successive bilingualism (Genesse, Hamers, Lambert, Mononen, Seitz, & Starck, 1978).

Simultaneous bilingualism occurs in early childhood, when a child learns two languages at the same time. They are considered to be learning a second language prior to the full grammatical development of the first, and therefore the two developing systems are said to interact more actively. It is also referred to as bilingual L1 acquisition (Meisel, 2001) because two languages develop together as first languages (two L1s). This could be as a result of dual language input from parents or caregivers. Simultaneous bilingual children acquire structure shared by both languages at approximately the same rate and in the same sequence (Kessler, 1971). In sequential bilingualism, on other hand, the first language (L1) and the second language (L2) are sequentially ordered, i.e., the acquisition of the second language happens after the child has acquired basic command and an established grammar in the first language, which for monolingual acquisition is typically taken to be roughly the age of 3-4 years (McLaughlin, 1978). They utilize this knowledge of the structures of the L1 as the foundation for the L2. The rate of mastery of each language depends on the amount of exposure each child gets in that language. Their literacy skills are still in the process of development, and thus schooling becomes an important mediating factor. Several such factors lead to differing levels of proficiency in the two languages.

Cognition is affected by the process of learning one or more languages. Working memory, an aspect of cognition, in particular, has been emphasized in studying language related cognitive functions in bilinguals. Bialystok (2009) showed that bilingual children exhibit an advantage in working memory. Working memory shows a clear-cut relationship with language acquisition on the basis of different sources of evidences (Vallar & Papagno, 2002).

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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 of sound elements in language. In Baddeley's model (Baddeley, Gathercole, & Papagno, 1998) PWM plays an important role in the learning of new words, whose unique phoneme sequences must be retained long enough to be assigned a semantic interpretation. In normal development, phonological memory skills correlates both with the existing vocabulary knowledge and the ease of learning new vocabulary either in native or foreign languages (Baddeley, 1998).

Different methods and stimuli have been used to study the PWM. One such method that has been recently researched upon is the use of nonword repetition (NWR) task. NWR task involves strings of letters or alphabets that are devoid of lexicality effects and that are not predictable as a word. Since repetition of nonwords calls for perception, storage and retrieval of its phonological constituents in a sequence, it is proposed as a potential task to identify the deficits related to phonological working memory in children. Gathercole and Baddeley (1990) suggested that nonword repetition allows a purer measure of short-term memory abilities than classic memory span tasks (i.e., digit span and word span). The ability to repeat words in an unknown language has been observed to predict success in learning that language. Conversely, inability to repeat pseudowords has been related with failure in L2 acquisition **(**Ardila, 2003).

A look into the literature revealed that NWR is influenced by the language knowledge and experience in the bilingual children. Thorn and Gathercole (1999) compared the nonword repetition abilities of English-French bilingual children. The children who were aged between 4 and 8 were classified as sequential (having acquired French 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 skill, but the sequential bilingual children's vocabulary score was 113 for English and 75 for French as found on questionnaire administered to parents. The investigators administered the French nonword repetition and English nonword repetition task on both the groups. The results indicated that wordlikeness effects were present only when the nonword stimuli were in the child's native language. The simultaneous bilinguals showed superior repetition of high than low word like nonwords in both English and French. But the sequential bilinguals showed superior repetition of high than low word like nonwords only in English.

Gutierrez-Clellen and Simon-Cereijido (2010) evaluated the clinical utility of nonword repetition task with a sample of Spanish-English bilingual children and to determine the extent to which individual differences in relative language skills and language use had an effect on the clinical differentiation of these children by the measures. A total of 144 Latino children (95 children with typical language development and 49 children with language impairment) were tested using nonword lists developed for each language. The results showed that the clinical accuracy of nonword repetition tasks varied depending on the language(s) tested. Test performance appeared related to individual differences in language use and exposure.

Summers, Bohman, Gillam, Pena and Bedore (2010) investigated Spanish-English sequential bilinguals' recall of Spanish-like and English-like items on NWR tasks and also assessed the relationship between performance on NWR, semantics and morphology tasks. Sixty two Hispanic children who were exposed to English and Spanish were taken as subjects. The children completed NWR tasks and short tests of semantics and morphosyntax in both languages. The results revealed that the children produced the Spanish-like nonwords more accurately than the English-like nonwords. Further NWR performance was significantly correlated to cumulative language experience in both English and Spanish.

Further, there are a few studies reporting the influence of syllable length on the NWR task. Simkin and Conti-Ramsden (2001) conducted a study to provide normative guidelines for three language measures lacking standardization for children in their final year of primary education. They used the Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996), the past tense task (Marchman, Wulfeck & Weismer, 1999) and the third-person singular task. Results revealed that there was a difference in the Children's Test of Nonword Repetition when the number of syllables was changed. The mean scores for nonword repetition at 2-syllable, 3-syllable, 4-syllable and 5-syllable are 9.84, 9.57, 8.97, and 8.98 respectively, i.e. the accuracy of the nonwords repeated decreased as the number of syllables increased. Few other studies reported the same findings (Gathercole, 2006).

**Need for the study**

A look into the literature revealed several studies conducted on the sequential bilingual children using the NWR task to study their PWM. These

studies were primarily carried out to assess the influence of language use and exposure on the PWM and they suggested that the bilingual children's language experience is divided across two languages. Since the sequential and simultaneous bilingual children differ in the context and manner of acquisition of languages, the usage and exposure of both L1 and L2, their performance on the NWR task could be different which needs to be investigated. Studying the performance on NWR in these types of bilingual children could enhance ones' understanding of the relationship between information processing and language learning. A few studies have focused on phonological working memory in different types of bilingual individuals using NWR tasks. However there are only limited studies comparing the two varieties of bilinguals such as the simultaneous and sequential on these aspects. Most of these have been carried out in the West. In the Indian context though there are studies using NWR tasks, most of them have been conducted in the monolingual population especially in children with communication disorders. There is a dearth of studies examining the performance of sequential and simultaneous bilinguals on nonword repetition. India being a multicultural and multilingual country provides a rich platform to conduct such studies. Hence the present study was carried out with the aim of comparing the performance of simultaneous and sequential Kannada-English bilinguals on a nonword repetition task and hence evaluating their phonological working memory. The specific objectives were to compare both the groups on the accuracy of nonwords and percentage of phonemes repeated and to analyze the type of errors exhibited during the nonword repetition.

## Method

### Participants

A total of 16 typically developing Kannada-English bilingual children in the age range of seven to eight years who were studying in second grade in different schools in Mysore were selected for the study. These bilingual children were classified into eight simultaneous bilinguals (6 males and 2 females) and eight sequential bilinguals (5 males and 3 females) based on the questionnaire (Harini & Shyamala, 2010). Children were classified as sequential when they acquired their mother tongue Kannada from birth and were exposed to English after they joined school at the age of 3.6years and simultaneous when they were exposed to both English and Kannada right from birth before they joined school. The WHO ten question disability checklist (Singhi, Kumar, Malhi, & Kumar, 2007) was administered to rule out any disability. International Second Language Proficiency Rating scale (ISLPR, Wylie & Ingram, 1995, 1999) was administered to check their language proficiency in English. 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 simultaneous bilinguals obtained a score of 3 and the sequential bilinguals obtained a score of 2 on ISLPR. The parents and also teachers handling the children were also consulted while rating these children for their language proficiency. The semantics and syntax section of Linguistic Profile Test in Kannada (LPT, Karanth, Ahuja, Nagaraja, Pandit, & Shivashankar, 1991) was administered to evaluate the language abilities in Kannada of children in both the groups. The simultaneous bilingual children obtained a mean overall raw score of 153 and the sequential bilingual children obtained a mean overall raw score of 166.7. They were also tested for the semantic and syntactic skills in English by administering the English language test for Indian children (Bhuvaneshwari & Jayashree, 2010) wherein the simultaneous and sequential bilingual children obtained a mean overall raw score of 142.10 and 141.10 respectively. Both the groups had age appropriate language abilities in both Kannada and English. Subjects were administered with Kannada articulation test (Babu, Rathna, & Bettageri, 1972) to rule out the articulatory errors. The subjects were also matched for their socioeconomic status based on the NIMH Socioeconomic status scale (Venkatesan, 2009).

### Stimuli

A list of nonwords (Shylaja & Swapna, 2010) was used as the stimulus. The nonwords were formed from meaningful Kannada words and differed in their syllable length. The list contained a total of 25 nonwords, with 20 nonwords as the test items (5 under each of the syllable lengths used) and 5 nonwords as the practice items. The list of nonwords were audio-recorded by a female native speaker of Kannada, using the "PRAAT" software (downloadable software for speech recording and analysis) loaded in the Compaq Presario C700 laptop system and then loaded into DMDX software to maintain a constant inter-stimulus interval of 4sec.

### Procedure

The list of 20 nonwords which differed in their syllable length were presented along with five practice items through DMDX software using headphones at the comfortable listening level to the individual participants, in a quiet listening

environment. Each participant was given the recorded instructions in Kannada through 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 five practice items was presented first followed by the test items. No feedback was given on the test items, but encouragement was given as required. The responses were audio recorded directly into the DMDX software and then transcribed verbatim by the experimenter. These recorded responses were also transcribed and analysed by another experimenter who was also an experienced speech-language pathologist for 10% of the sample. The nonwords were analysed for overall accuracy, accuracy at different syllable lengths (2-, 3-, 4- and 5-syllable) and error analysis.

**Scoring**

The accuracy of each of the individual's responses was calculated as the whole word correct or incorrect. The exact repetition of the nonwords was scored as "1". Any syllable substitutions, omissions and additions were considered as incorrect and scored as "0". The total number of the nonwords correct were calculated and tabulated.

The total number of vowels and consonants repeated correctly and the total number of different types of errors such as substitutions, additions, omissions was averaged across the different syllable lengths. The total percentage of vowels correct, the total percentage of consonants correct and the type and percentage of errors namely, substitution, omission, addition errors were calculated from the raw scores. 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. The total percentage of different errors was also computed in a similar manner for each subject for the entire set of nonwords and also at each different syllable lengths.

These results were subjected to the statistical analysis in SPSS software (version 16). Descriptive statistics was used to compute the mean and standard deviation. Other statistical procedures like Mann- Whitney U test was carried out to answer the research questions. The inter-rater reliability was carried out and the cronbach's coefficient (α) ranged from 0.73-0.99 which suggested a good inter-rater reliability between the two judges.

## Results

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

I. Accuracy of responses
II. Error analysis

### I. Accuracy of responses

### a. Overall accuracy of responses

The accuracy of the responses was determined by calculating the total number of nonwords repeated correctly. The mean and standard deviations were computed and the values for both the groups are depicted in Table 1. The overall mean score for the accuracy of nonword repetition task in the simultaneous bilinguals was 10.88 (SD= 3.83), which was lesser than 14.50 (SD=3.12) the mean obtained by the sequential bilinguals. This indicated that the simultaneous bilinguals had lower accuracy than the sequential bilinguals for the NWR task. This has been depicted graphically as shown in Figure 1.

To determine whether any significant difference existed between the performances of both the groups as a whole, Mann Whitney U test was administered and the results revealed that there was significant difference between sequential and simultaneous bilinguals. The /z/ values have been depicted in Table 1.

Table 1. *Mean, standard deviation (SD), and /z/ values for accuracy of responses in both the groups.*

| Accuracy of Responses | Group | Mean | SD | /z/ values |
|---|---|---|---|---|
| A2s | Simultaneous | 3.75 | 0.71 | 0.56 |
| | Sequential | 4.00 | 0.93 | |
| A3s | Simultaneous | 3.50 | 1.41 | 0.76 |
| | Sequential | 4.00 | 1.20 | |
| A4s | Simultaneous | 2.63 | 1.69 | 2.05* |
| | Sequential | 4.25 | 0.89 | |
| A5s | Simultaneous | 1.00 | 0.76 | 2.00* |
| | Sequential | 2.25 | 1.28 | |
| Overall Accuracy | Simultaneous | 10.88 | 3.83 | 2.01* |
| | Sequential | 14.50 | 3.12 | |

Note: A2s- accuracy at 2-syllable length nonwords; A3s-accuracy at 3-syllable length nonwords; A4s-accuracy at 4-syllable length nonwords; A5s-accuracy at syllable length nonwords; *p<0.05.

On specific examination of the performance of the two groups across different syllable length, it was seen that there was a statistically significant difference in the performance on 4- and 5-syllable length nonwords and also in the overall accuracy of the nonwords ($p<0.05$) as revealed by Mann Whitney U test. Moreover there was a decrease in the accuracy of the nonword repetition responses in both the groups with the

increase in the syllable length. The sequential bilingual children had significant difficulty in repeating 5-syllable length nonwords, whereas the simultaneous bilingual children had difficulty in repeating both 4- and 5-syllable nonwords as revealed by the mean values shown in Table 1.

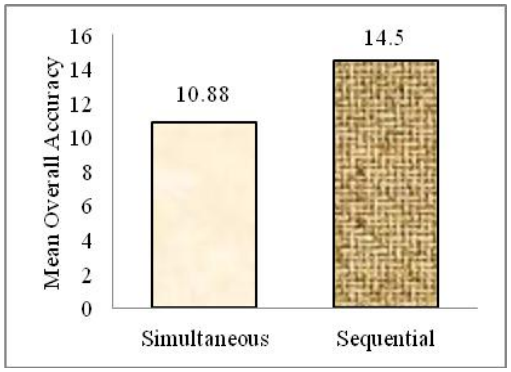


Figure 1. *Mean accuracy of responses on the NWR task in both the groups.*

**b. Percentage of vowels and consonant correct across both the groups:** The mean and standard deviation values for overall Percentage of Vowels Correct (PVC) and Percentage of consonants Correct (PCC) for the entire task and at each syllable length for both the groups are shown in Table 2.

The overall mean scores of PVC for the sequential bilinguals was (mean= 96.07, SD= 2.38) was higher than that of simultaneous bilinguals group (mean= 92.14, SD= 5.12). The mean values at 3-syllable, 4-syllable and 5-syllable of the sequential bilinguals were also higher than the simultaneous bilinguals. The PVC also decreased from 2-syllable nonwords to 5-syllable nonwords, that is, the errors increased from shorter syllable length to the longer syllable length nonwords in both the groups. In a similar manner the mean scores of PCC at different syllable lengths and as a whole was higher for sequential (mean=92.68, SD= 8.10) than simultaneous bilinguals (mean= 83.93, SD=14.30). The same has been depicted in Figure 2. On the basis of mean scores, it can be stated that the sequential bilinguals repeated greater number of phonemes including vowels and consonants accurately. However, both the groups had higher percentage of vowels correct compared to the percentage of consonants. This suggests that both the groups had more difficulty in repeating consonants than vowels.

Table 2. *Mean, standard deviation (SD)* and / z / *values of PVC and PCC at different syllable lengths for both the groups.*

| Syllable length | Group | PVC | | | PCC | | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | /z/ values | Mean | SD | /z/ values |
| 2s | Simultaneous | 98.75 | 3.54 | 0.62 | 87.50 | 7.07 | 0.66 |
| | Sequential | 97.50 | 4.63 | | 90.00 | 11.95 | |
| 3s | Simultaneous | 95.00 | 7.77 | 0.37 | 85.83 | 17.62 | 0.96 |
| | Sequential | 97.50 | 3.45 | | 92.50 | 14.00 | |
| 4s | Simultaneous | 90.00 | 11.95 | 0.86 | 86.25 | 14.58 | 1.66 |
| | Sequential | 98.13 | 2.59 | | 96.88 | 4.58 | |
| 5s | Simultaneous | 89.50 | 6.02 | 1.28 | 79.50 | 19.06 | 1.65 |
| | Sequential | 93.00 | 4.14 | | 90.50 | 9.55 | |
| Overall | Simultaneous | 92.14 | 5.12 | 1.91 | 93.93 | 14.30 | 1.64 |

Note: PVC - percentage of vowels correct; PCC –percentage of consonant correct; 2s- 2-syllable nonwords, 3s- 3-syllable nonwords; 4s-4-syllable nonwords; 5s- 5-syllable nonwords

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Mann Whitney U test was done to find whether there was significant difference between both the groups in the total PCC and total PVC for the overall nonword repetition task and also at different syllable length nonwords. The results of the test indicated that there was no significant group difference ($p>0.05$) in the total PVC and total PCC for the overall non word repetition task and also at different syllable lengths. These results are depicted in Table 2.

**II. Error analysis in the nonword repetition task**

**Percentage of syllable substitution, addition and omission:** The mean and standard deviation values for Percentage of Syllable Substitution (PSS), Percentage of Syllable Addition (PSA) and Percentage of Syllable Omission (PSO) were calculated for nonwords at different syllable length and for the overall non word repetition task which are shown in Table 3. Both the groups had higher substitution errors, followed by omission errors and almost no addition errors. The same has been depicted in Figure 2. A specific examination of the PSS revealed that the simultaneous bilinguals had higher PSS than sequential bilinguals overall and at different syllable lengths. The values of PSA shown in the Table 3 also indicate that at 4- and 5-syllable length, only one child in simultaneous group had syllable addition error. All other children in both

the groups did not exhibit syllable addition errors. The simultaneous bilinguals also had higher PSO than sequential bilinguals group at 3- and 4-syllable lengths and at overall nonword repetition task. There was no syllable omission at 2-syllable length.

The results of Mann Whitney U test indicated that there was a significant difference between the two groups only in the PSS at 5-syllable length and the overall percentage of syllable substitution where in the simultaneous bilingual group had higher PSS indicating more errors than sequential bilingual group. The /z/ values are depicted in Table 3.

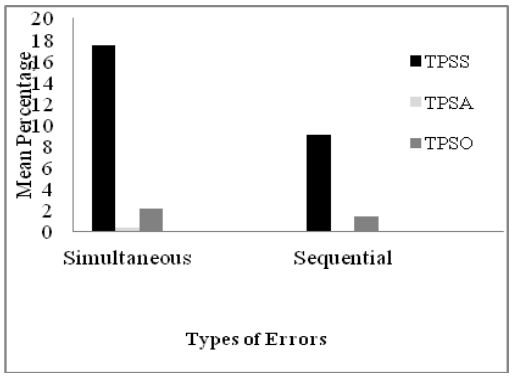


Figure 2. *Representation of the error types in both the groups.*

Table 3. *Mean, standard deviation (SD) and /z/ values of PSS, PSA and PSO across different syllable lengths for both the groups.*

| Syllable length | Group | PSS | | | PSA | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | /z/ values | Mean | SD | z/ values | Mean | SD | /z/ Values |
| 2s | Simultaneous | 13.75 | 7.44 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Sequential | 12.50 | 11.65 | | 0.00 | 0.00 | | 0.00 | 0.00 | |
| 3s | Simultaneous | 11.67 | 14.58 | 0.78 | 0.00 | 0.00 | 0.00 | 3.33 | 3.56 | 0.49 |
| | Sequential | 6.67 | 11.27 | | 0.00 | 0.00 | | 2.50 | 3.45 | |
| 4s | Simultaneous | 15.63 | 14.25 | 1.94 | 0.63 | 1.77 | 1.00 | 2.50 | 7.07 | 1.00 |
| | Sequential | 5.00 | 6.55 | | 0.00 | 0.00 | | 0.00 | 0.00 | |
| 5s | Simultaneous | 24.00 | 9.32 | 2.46* | 0.50 | 1.41 | 1.00 | 1.50 | 2.98 | 0.51 |
| | Sequential | 12.50 | 6.57 | | 0.00 | 0.00 | | 2.50 | 4.24 | |
| Overall | Simultaneous | 17.50 | 9.06 | 2.22* | 0.36 | 1.01 | 1.00 | 2.14 | 3.05 | 0.28 |
| | Sequential | 9.11 | 7.00 | | 0.00 | 0.00 | | 1.43 | 2.02 | |

Note: PSS - Percentage of Syllable Substitutions; PSA - Percentage of Syllable Additions; PSO - Percentage of Syllable Omission; 2s- 2-syllable length nonwords, 3s- 3-syllable length nonwords; 4s-4-syllable length nonwords; 5s- 5-syllable length nonwords, *p<0.05

## Discussion

The present study aimed to compare the PWM in simultaneous and sequential Kannada-English bilinguals using NWR task. The results revealed that the performance of sequential bilinguals was better on nonword repetition task compared to the simultaneous bilinguals. The superior performance of the sequential bilingual children could be attributed to the age of acquisition effects of the second language, context of acquisition of the second language and also on the amount of exposure and use of the first and second language. The simultaneous bilingual children at least initially could have had lesser exposure to each language which might have led to the difficulty in forming representations of newly encountered sound sequences and hence poor nonword repetition scores. Similar conclusions have also been drawn by Hoff & McKay (2005). Gutierrez-Clellen & Simon-Cereijido (2010) also indicated the influence of language use and exposure on the performance of the bilingual children considered in their study.

There is evidence in literature to support the fact that the bilingual children and young adults have smaller vocabularies in each of their languages than monolinguals (Pearson, 1993; Pearson, Fernandez, Lewedeg, & Oller, 1997; Thorn & Gathercole, 1999; Hoff & Elledge; 2003). Sequential bilingual children are monolinguals up to a certain age after which they acquire their second language and hence could have had a larger lexicon. Further, Hoff & McKay (2005) suggested that young children, who live in an environment that requires them to learn two languages initially, build their vocabularies at a slower pace than children acquiring only one language. They also reported that the 23 month old monolinguals outperformed the bilinguals on the NWR task which indicated that monolinguals are better on phonological skills. These findings extend support to the present study.

In general, the children included in both the groups were not balanced bilinguals. Rather, the sequential bilingual children were more dominant in Kannada because they had acquired

Kannada first in their life and less dominant in English as revealed by the tests administered. Specifically, although both the groups of children had age appropriate language abilities in Kannada on the LPT (Karanth et al., 1991), a closer examination of the raw scores revealed higher semantic and syntactic abilities in the sequential bilingual children (overall mean raw score of 166.7) and hence their deeper and more abundant knowledge of Kannada language would have influenced the performance, since the nonwords were Kannada based. This is in accordance with the threshold hypothesis proposed by Cummins (1979, 1981, & 1984) and Toukomaa and Skutnabb-Kangas (1977) where in they stated that a higher proficiency in language reflect better cognitive abilities. Further studies do reveal a word likeness effect on repetition task (Summers et al., 2010). On the other hand, the simultaneous bilingual children were more proficient in English since their parents used English more frequently even during daily conversation at home. This was also revealed by the higher scores obtained in English on the ISLPR (Wylie & Ingram, 1995, 1999) administered, wherein the simultaneous bilinguals obtained a score of 3 and the sequential bilinguals obtained a score of 2. Further, it was observed that the simultaneous bilingual children were more fluent, proficient, confident and produced more grammatically complex sentences in English during an informal conversation compared to the sequential bilingual children. They also preferred to answer questions in English than in Kannada. The children obtained higher scores on the English language Test for Indian Children (overall mean raw score of 142.10) which was administered to assess their language abilities. This could be because of their exposure to English language since birth.

Further, several earlier studies have reported a positive correlation between language skill and nonword repetition performance (Ellis Wiesmer, Tomblin, Zhang, Buckwalter, Chynoweth & Jones, 2000; Montgomery, 2002; Roy & Chiat, 2004; Gutierrez-Clellen & Simon-Cereijido, 2010). A number of studies on groups of typically developing children ranging from 3 to 5 years of age have revealed correlation between nonword repetition and children's receptive and expressive vocabulary size. Associations have also been found between nonword repetition and indices of speech output including repertoire of vocabulary, utterance length, and grammatical complexity (Adams & Gathercole, 1995, 2000; Summers et al., 2010). Adams & Gathercole (2000) found that children with typical language development who had better nonword repetition skills produced speech with a broader vocabulary, longer utterances, and a greater range of syntactic constructions than children with relatively poor nonword repetition skills. Hence the results of the present study where in the sequential bilingual children with better syntactic abilities in Kannada obtained better scores on Kannada based nonword repetition task is in agreement with the above mentioned studies. In addition there are evidences which suggest that the brain organization is different for individuals acquiring languages in a sequential manner compared to those acquiring languages simultaneously (De Houwer, 2005) which could have played a role in the superior performance seen in sequential bilinguals in this study.

The simultaneous bilinguals had a significant difficulty especially in repeating nonwords of 4 and 5 syllables, while sequential bilinguals had a significant difficulty only at the 5 syllable level. It was observed that as the syllable length increased, there was a concurrent increase in errors in the nonword repetition in both the groups. These results are in consensus with the earlier studies by Simkin & Conti-Ramsden, 2001; Gathercole, 2006) wherein they concluded that the accuracy of the nonwords decreased while the number of syllables increased in typically developing children. This could be a result of limited capacity nature of the phonological short-term memory.

The simultaneous bilinguals had a higher percentage of vowel and consonant errors compared to sequential bilinguals except at 2-syllable length. However, both the groups had higher percentage of vowels correct compared to the percentage of consonants. This suggests that both the groups had more difficulty in repeating consonants than vowels. The results of the present study are in consonance with the study done by Girbau and Schwartz (2008) who concluded that vowels are preferentially preserved in the phonological working memory task in typically developing children and in with children with SLI.

The results also indicated that the simultaneous bilinguals had significantly higher percentage of syllable substitution than sequential bilinguals overall and at different syllable lengths. In addition the percentage of syllable addition and omissions were also found to be higher in simultaneous bilinguals. The lesser errors in the sequential bilingual children compared to the simultaneous bilinguals could be due to their better syntactic abilities in Kannada language as

revealed through the language test administered (LPT, Karanth et al., 1991). However the syllable substitutions were found to be the most common error type in both the groups. These results are in consonance with the results of the earlier studies done by Marton and Schwartz (2003) and Girbau and Schwartz (2008) who found that consonant substitutions were the most frequent type of error found in both the children with typical language development and SLI.

## Conclusions

It can be concluded from the present study that sequential bilinguals have better phonological memory than the simultaneous bilinguals since they performed better on the nonword repetition task. Further it can also be concluded that the language dominance and the amount of exposure to the two languages in the bilinguals plays an important role in determining their performance on different tasks. However, caution has to be exercised while generalizing the results since the number of subjects included was limited in this study. Hence multiple replications of the study are recommended. However, this study provides an insight into the phonological working memory skills in bilingual individuals who have acquired their languages in a different manner. In addition the findings of such research might contribute to theories related to language processing in bilinguals. Further research is warranted to examine the effects of bilingualism on both the languages the child is acquiring, longitudinal studies of the predictive relations between phonological skills, phonological memory and vocabulary growth, considering a large sample of subjects, in different languages, in different age groups and in different types of bilingual population.

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